~~SECRET~~

No 63

2000

ECONOMIC INTELLIGENCE REPORT

THE ELECTRIC BATTERY INDUSTRY OF THE SINO-SOVIET BLOC

CIA/RR 130
1 May 1958

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

~~SECRET~~

~~S-E-C-R-E-T~~

ECONOMIC INTELLIGENCE REPORT

THE ELECTRIC BATTERY INDUSTRY OF THE SINO-SOVIET BLOC

CIA/RR 130

(ORR Project 36.1555)

CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

~~S-E-C-R-E-T~~

~~FOREWORD~~

The emphasis of this report is on estimates of the total value and the composition of production of electric batteries in the Sino-Soviet Bloc and on estimates of trade patterns, use patterns, and inputs. Production in each country of the Bloc has been estimated independently, the sum of these estimates equaling the total for the Bloc.

Estimates of the value of production and the physical quantity of production are given for 1938 and for 1946-63. Administrative organization, trade, use patterns, and inputs are given only for the latest year available.

No attempt has been made to treat exhaustively the pattern of input and consumption. The inputs given are estimated physical quantities of the most essential materials and labor, and a use pattern has been determined for broad consuming sectors.

Data for 1957 included in this report represent a first approximation subject to subsequent refinement.

~~S-E-C-R-E-T~~

CONTENTS

~~S-E-C-R-E-T~~

[p iv blank]

Page

Appendixes

Tables

Illustrations

CIA/RR 130
(ORR Project 36.1555)

~~S-E-C-R-E-T~~

THE ELECTRIC BATTERY INDUSTRY OF THE SINO-SOVIET BLOC*

Summary

The estimated value of production of electric batteries** in the Sino-Soviet Bloc*** during 1957 was US $449 million,**** which almost equaled the $453.5 million worth of batteries produced in the US in 1954. Of the value of production in the Bloc, the USSR contributed about $373 million, or more than 80 percent of the total. The other significant producer in the Bloc was East Germany, with about 7 percent of the total value of production.

The estimated annual value of production of batteries in the Sino-Soviet Bloc exceeded the prewar level in 1946, doubled between 1946 and 1950, more than tripled between 1950 and 1957, and is expected to increase approximately two and one-half times between 1957 and 1963. From 1946 through 1957 the USSR consistently has provided about four-fifths of the total value of production of batteries in the Bloc. The average annual rate of growth of the value of production of batteries in the Bloc between 1950 and 1957 was about 18 percent. In the US the comparable rate of growth was less than 3 percent between 1947 and 1954.

Of the value of production of batteries in the Sino-Soviet Bloc in 1956, storage batteries accounted for 73 percent and primary batteries for 27 percent. More than 40 percent of the value of production of batteries in the Bloc in 1956 was allocated to military applications, with batteries for the propulsion of submarines accounting for about one-quarter of the military requirements for batteries. Compared with US production in 1954, the Bloc in 1956 produced only 35 percent of the value of production of automotive batteries but more than three times the value of production of alkaline batteries.

* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 January 1958.

** The term batteries as used in this report always refers to electric batteries.

*** The term Sino-Soviet Bloc as used in this report includes the USSR, Bulgaria, Czechoslovakia, Communist China, East Germany, Hungary, Poland, and Rumania. Albania is not included, because batteries are not produced there.

**** Values are given in 1955 US dollars throughout this report.

The battery industry of the Sino-Soviet Bloc requires significant quantities of nonferrous metals. The requirements for the most important of these in 1956 were lead, 145,300 metric tons*; antimony, 8,700 tons; nickel, 6,200 tons; cadmium, 700 tons; and zinc, 29,500 tons. Shortages of these metals have limited production of batteries in the Bloc, particularly in the European Satellites.

The Sino-Soviet Bloc generally has been able to meet its requirements for industrial and military batteries but has not been able to meet the demand for consumer batteries, particularly radio batteries. The quality of batteries produced in the Bloc usually is adequate for its needs although generally inferior to batteries produced in the US or Western Europe. Inferior batteries are costly to the Bloc in terms of reduced reliability, high rates of replacement, and waste of scarce raw materials.

Although research and development appear to be on a par with efforts in the West, the new designs and production techniques acquired by the Sino-Soviet Bloc have been adopted only after a serious time lag. Consequently, applied technology in the Bloc lags behind that of the West by about 5 to 10 years.

As a result of backward technology, obsolete equipment, and the large requirements for scarce metals, the battery industry of the Sino-Soviet Bloc appears to be a high-cost industry compared with the battery industries of Western countries. Apparently, only the desire of the Bloc to be independent of foreign supply prevents imports of batteries from non-Bloc countries on a significant scale.

To correct the shortcomings of its battery industry and to expand rapidly its volume of production of batteries, the USSR intends to mechanize and to automate on a large scale. This program is to be instituted by 1960. Other countries of the Sino-Soviet Bloc have less ambitious plans but also intend to improve the quality and to enlarge the volume of their production of batteries through research, investment, and training. The investment program of the USSR seems rational in terms of replacing manpower, which is becoming relatively more expensive, with capital equipment, which is becoming relatively cheaper. In addition, the mechanization and automation of production of batteries will expand the volume of production while improving quality, will conserve scarce raw materials, and will enable the industry to produce new designs which could not be manufactured with present equipment.

* Tonnages are given in metric tons throughout this report.

I. Introduction.

A. Nature and Uses of the Product. 1/*

Batteries are of two general types -- the primary type and the secondary, or storage, type. The generation of electricity in both types is accomplished by chemical reactions, but in different ways.

Primary batteries generate electricity by consuming such materials as zinc and sal ammoniac. This type of battery cannot be used after it is exhausted, without replacing the used materials.

Storage batteries, however, have a reversible chemical reaction: that is, when the battery is completely discharged, it can be restored by passing a current through it in the opposite direction from that of the discharging current. Although the length of life and output of a primary battery is very limited, the storage battery may be used for heavy-duty purposes which require large capacity and heavy current drains.

An electrochemical couple is the term used to describe two dissimilar substances which have a chemical reaction resulting in production of electricity. One couple, regardless of size, has a specific voltage determined by the chemical properties of the substances composing the couple. The larger the size of the couple, however, the larger its capacity in terms of amperes of electric current.

A single couple is commonly encased in a container and called a cell, whether it is of the primary or storage type. A battery is simply a group of cells connected together. If like polarities are connected (plus to plus and minus to minus), the voltage of the battery remains that of a single cell, and the capacities of the cells are additive. If unlike polarities are connected (plus to minus), the voltages of the cells are additive, but the capacity of the battery remains that of a single cell. The voltage of a primary cell never exceeds 2.5 volts for any couple and is commonly about 1.5 volts. The voltage of a storage cell never exceeds 2 volts. The most common couple for primary batteries is zinc with manganese dioxide. Mercury and alkaline couples are in the developmental stage. Primary batteries can be either wet or dry, although the dry battery is typical. For storage batteries the most popular couples are lead-acid (sulfuric), nickel-iron, and nickel-cadmium. Zinc-silver batteries and zinc-nickel batteries are in the developmental stage. Storage batteries always are made of wet cells.

* For serially numbered source references, see Appendix E.

Batteries are used as a source of direct current power for the following four main applications: (1) recurring heavy current drains which require many cycles (a cycle is 1 discharge and 1 charge), (2) constant light current drains, (3) intermittent current drains, and (4) nonrecurring heavy current drains. Storage batteries, of course, could be used for all of these applications, but application (1) is most suited to their nature. A good example of application (1) is the submarine battery, which propels a boat while discharging and later is recharged by generators. When storage batteries are used in applications (2) and (3), they usually are put on a floating circuit, where the battery is constantly being charged except for brief periods of discharge. Examples of application (3) are telephone batteries to provide steady voltage and the automotive battery which starts an automotive vehicle and is charged constantly by the generator. In application (4) the storage battery commonly is destroyed after use, as in a guided missile. Such a storage battery is called a reserve battery, and it only is activated immediately before use. Primary batteries can be used in all applications except (1), in which they cannot be charged. Examples of the types of primary batteries for the various applications are railroad signal batteries for application (2), radio batteries for application (3), and batteries for shell fuses or guided missiles for application (4).

In manufacture the essential ingredients for a superior product, on the assumption of a good design, are electrolytically pure materials and accurately controlled manufacturing processes. Poor-quality materials result in a product with low capacity and short life. Poorly controlled manufacturing processes result in a product which does not live up to its design capability and may give erratic performance.

B. Definition of the Industry.

The battery industry is composed of those manufacturing facilities which produce either primary or storage batteries. Each plant included in the industry produces finished batteries, although there are variations between plants in their degree of production of materials for battery components and other products. The majority of plants producing storage batteries receive pig lead, sulfuric acid, nickel, cadmium, silver and steel, rubber, or plastic battery containers from other plants which specialize in production of these battery inputs. Plants producing primary batteries for the most part import zinc (in bulk form), manganese dioxide, paper, flour, sal ammoniac, pitch, and other miscellaneous materials which are fabricated at the battery plants.

Facilities which produce other commodities as well as batteries are included, but an attempt has been made to estimate only the production of batteries. For example, many manufacturers of primary batteries also produce flashlights and/or radios, and manufacturers of storage batteries for miners' lamps also produce the lamps.

In most countries the facilities used to produce primary batteries are separate from those producing storage batteries because the productive processes have little in common. In general, storage batteries are produced in fewer, larger plants than are primary batteries, which require less capital equipment and more labor than storage batteries. Battery plants, regardless of the type of batteries produced, usually are located near the centers of consumption of their products, partly because of the economy of transporting the material inputs to the factory relative to the price of shipping and handling finished batteries and partly because of the fact that activated storage batteries* as well as primary batteries are perishable commodities which deteriorate with time and handling.

Battery plants usually diversify their production. Storage battery plants may specialize in automotive types of starting, lighting, and ignition (SLI) batteries if the demand for the product is large as in the US and, to a lesser extent, in the USSR. Typically, however, each plant will produce several types of storage batteries. The product mix can be changed readily because nonspecialized operations and equipment are used. The same degree of diversification is usually true of the primary battery industry although exceptions are found, particularly in small firms producing only flashlight cells.

C. Importance of the Industry. 2/

Batteries are used widely throughout the civil and military communities as standby power sources for aircraft emergency apparatus, hospital lighting, shipboard communications, telephone and telegraph service, and control of circuits of electric power plants. There are also many special military applications such as power sources for fuses for shells and mines, for guided missile control systems, and for radio communications; motive power for submarines and electric torpedoes; and conventional SLI service for tanks, trucks, aircraft, and other vehicles.

Two important civil uses of batteries are in SLI service for automobiles, trucks, locomotives, and tractors and in the lighting of flashlights and lanterns. There are other necessary applications of batteries. Much of industry could not operate effectively without the use of batteries. Coal mining operations, for example, depend heavily

---

* Activated storage batteries are those in which the electrolyte has been added to the active materials and the battery is operational.

on electric locomotives and electric miners' lamps. Hearing aids powered by batteries are necessary to many people. Radiosondes powered by batteries are essential in gathering meterological information for weather forecasting and scientific data for basic research. In fact, many scientific measuring and recording instruments can be powered only by batteries. Future scientific electronic developments will expand further the requirements for special-purpose batteries. A current example of such a development is the battery which is required as a power source for scientific recording and transmitting instruments contained in earth satellites being sent beyond the atmosphere of the earth. Solar-cell mercury batteries will be used to convert radiation from the sun into electric power in the earth satellites.

An example of battery developments which broaden the field of battery application is the development of the atomic battery. Although not yet perfected, the atomic battery probably can be used in the near future to power wrist watches, small radios, and hearing aids, as well as for many other applications in the military and scientific fields. Such batteries will last from 5 to 20 years and will be no larger than a button.

From the above discussion of the wide application of batteries throughout science, industry, and the military, it is obvious that the battery industry of any country will have a far-reaching influence on its welfare and strength.

II. History, Organization, and Technology.*

A. USSR.

1. Organization. 3/

Before the recent reorganization of the electrotechnical industry of the USSR on a regional basis, all of the major manufacturing facilities for both primary and storage batteries were subordinate to the Ministry of the Electrotechnical Industry of the USSR and were directly controlled by Glavakkumulyatorprom (Glavnoye Upravleniye Akkumulyatornoy, Elementnoy i Elektrougol'noy Promyshlennosti -- Main Administration of the Storage Battery, Battery Cell, and Electrocarbon Industry). Several minor plants which produce automotive storage batteries or flashlight and radio primary batteries were subordinate to various republic or local ministries in their respective locations, primarily in the thinly populated areas of Siberia. All battery plants are now presumably subordinate to the respective economic councils of their respective economic regions.

* For further details and documentation, see Appendix B.

2. History and Technology.

The first plant for manufacturing storage batteries in the USSR was established in Leningrad in 1897 by the German subsidiary of the British Tudor firm. Another similar plant was established in Leningrad in 1912 by the same firm. Moselement, a plant for manufacturing primary batteries, was established by the Soviet government in 1929 in Moscow. During the 1930's, several new plants were established for production of all types of storage and primary batteries. Most of these plants were relocated partially or wholly during World War II.

After the war, old plants were rebuilt and expanded, and new plants were constructed. Much of the equipment required by the expansion of the industry came from dismantled German plants. The locational pattern, shown in the accompanying map, Figure 1,* indicates that the industry is dispersed geographically, although concentrations of production appear at Saratov, Leningrad, Komsomol'sk, and Moscow and its surrounding area.

At present the Soviet battery industry is expanding output rapidly, but applied technology is lagging. The Minister of the Electrotechnical Industry, I. Skidanenko, has stated that although much new technology has been developed by the scientific research institute,** very little is adopted by the manufacturing organizations. 4/ In the area of conductor coatings for the plate type of battery, for example, plants still are using the old technology of 1941. In the area of pasting technology for lead-acid storage batteries the plants are still using the paste composition and application techniques of 1950 or earlier.

In a recent statement of policy, Glavakkumulyatorprom announced that all of its plants would be specialized and mechanized increasingly. The scientific research institutes therefore were directed to give more aid to the manufacturing plants. The main steps outlined for improving production were use of powder metallurgy for making lead-acid batteries, mechanization of constant-flow production, standardization

---

* Inside back cover.

** The Scientific Research Battery Cell and Electrocarbon Institute (Nauchno-Issledovatel'skiy Elementno-Elektrougol'nyy Institut -- NIEEI) performs research on new product types and production techniques, whereas the Central Design Bureau of the Electrical Drive Trust (Tsentral'noye Konstruktorskoye Byuro "Elektroprivod" -- TsKB "Elektroprivod") and the All-Union Scientific Research Institute of Electric Welding Equipment (Vsesoyuznyy Nauchno-Issledovatel'skiy Institut Elektrosvarochnogo Oborudovaniya -- VNIIEO) develop specialized units for mechanizing and automating various production processes.

of parts and organization of their mass production, use of paste technology for coating the electrodes of primary batteries, and automation of quality control operations. 5/ This statement of policy was reinforced and explained in detail at a conference of directors, chief engineers, and leading workers of Glavakkumulyatorprom in February 1956. 6/

From the above statements of highly placed executives of Glavakkumulyatorprom, it is a fair inference that the battery industry in the USSR is lagging technologically and is striving desperately to overcome its backwardness by an intensive program of technological improvement in both product design and production techniques. More concrete evidence exists in the technical evaluation of two Soviet primary batteries and a nickel-cadmium storage battery. In the opinion of the evaluators the Soviet batteries did not perform nearly so well as comparable US designs. Impure materials, lack of manufacturing skill, and loose design were the primary factors contributing to the inferiority of the Soviet batteries. 7/

In spite of the technological shortcomings of the battery industry in the USSR, research and development have been carried out in an apparently successful manner. Although the operating plants have been neglected, the research facilities have developed the VDL* series of new primary cells. These are alkaline cells with air depolarization which primarily are used by the Ministry of the Communications Industry as power sources for both radio transmitters and receivers. Although superior to the manganese dioxide depolarized dry cells now in use, the VDL cell has not gone into production because of its higher cost. 8/

Another new primary cell which is important to communications in the USSR is the VDZh**-400 iron-carbon alkaline cell. This cell has a long shelf life, can operate at low temperatures, and has a specific power by weight and volume that is double that of lead-acid cells. Although this cell is not in production at present, it appears that its main advantage will be its low cost because it contains no nonferrous metals. 9/

In addition, Soviet research has produced a working thermal generator, or fuel cell, which is being produced in limited quantities to replace true batteries*** in such low-power applications as power

* The probable expansion is vozdukho-depolyarizovannaya latun' (air-depolarized brass).

** The probable expansion is vozdukho-depolyarizovannoye zhelezo (air-depolarized iron).

*** A true battery stores electrical energy, whereas fuel and solar cells merely convert heat energy to electrical energy without storing it. These cells are actually electrical generators.

sources for small radio transmitters and receivers. Research is continuing in the USSR, as it is in the US, to develop fuel cells with large power outputs in order to transform fossil fuels directly into electric power without use of mechanical rotating machinery. 10/ Other battery types in an experimental stage are solar batteries, which transform radiation from the sun directly into electricity; gas batteries, which contain no metal and which use carbon and an acid or common salt electrolyte; and atomic batteries, which use a radioactive material to produce a small current at a high voltage. None of these types has been developed yet sufficiently for practical applications. Developments for some practical applications, however, may occur by 1960. 11/

Basic research on the lead-acid storage battery is far less startling but more important in the short run than the above developments. The lead-acid storage battery is the bread-and-butter battery of the world, as well as of the USSR, even though it was invented in 1869. Soviet researchers apparently have been very thorough in exploring corrosion-resistant alloys for grids of lead-acid storage batteries. They found that silver materially decreases the corrosion of the positive grids and that tellurium, sulfur, calcium, and copper, as well as silver, help the negative grids resist corrosion. 12/ Economic application of these findings could prolong significantly the life of lead-acid storage batteries.

Research also is being directed in the USSR and in other countries toward batteries which will deliver high outputs at low temperatures and toward reserve batteries which can be stored indefinitely without electrolyte and can be quickly activated by the addition of electrolyte, when power is desired. Batteries of this type have many applications, especially for the military in guided missiles, torpedoes, fuses, sonobuoys, arming devices for mines, and emergency devices in aircraft. Power requirements per unit of weight are very great in these applications.

One very promising type of battery, which may answer some of the requirements posed above, is the silver-zinc storage battery. This battery has a power output per unit of weight which is about five times or more higher than that of either the lead-acid or nickel-cadmium types of battery. It is still not completely reliable and does not perform well at low temperatures, but development appears to be intensive. In the US these batteries are being developed primarily for application in guided missiles and homing torpedoes. The French navy is interested in them as a source of power for submarines. There is some indication of large purchases of silver by the USSR from Communist China. These purchases could indicate that the USSR is interested in a silver-zinc submarine battery because about 48 tons of silver are required to produce 1 submarine battery of the silver-zinc type. 13/

B. East Germany.

1. Organization. 14/

Since the formation of East Germany, the battery industry has been subordinate to the Ministry of General Machine Building (Ministerium fuer Allgemeinen Maschinenbau). Within the Ministry, however, the battery industry has been shifted from the Main Administration for Cable and Equipment Construction (Hauptverwaltung Kabel- und Apparatebau), which was abolished, to the Main Administration for Electrical Machinery (Hauptverwaltung Elektromaschinenbau), although it is possible that some communications batteries are manufactured under the Main Administration for Radio and Telecommunications Technology (Hauptverwaltung Rundfunk- und Fernmeldetechnik).

2. History and Technology.

The territory that is now East Germany produced only 15 percent of German batteries before World War II but shared in the significant German development of the sintered-plate nickel-cadmium battery. 15/ This battery is able to sustain high rates of discharge while having the other advantages of the nickel-cadmium couple -- long life, dependability, good cold-weather performance, and little maintenance. It also shares, however, the disadvantage of high initial cost. Today the sintered-plate nickel-cadmium battery is being used in many military applications where high rates of discharge are required, such as in the starting of aircraft and in control systems for guided missiles. The battery is still being developed for better performance characteristics in the US.

It is estimated that East Germany today retains little of the good technology developed and applied before World War II. The German battery industry was well developed before World War II and led the world in battery technology. When the USSR dismantled the battery plants after World War II, however, much good equipment was lost and never replaced. A recent technical evaluation of a radio dry cell produced in East Germany indicated that the manufacturing process was very poor and that inferior materials were used. 16/ Much of the inferiority of East German batteries is a result of the difficulty in securing good materials and machinery.

East Germany may have retained some of its good technicians, however, for in 1953 it was able to produce silver-zinc batteries for the USSR. 17/ In 1954 a fairly good low-temperature dry cell was developed for use in radiosondes. 18/ Other projects currently under way include the development of a process for the recharging of dry cell batteries and the development of a solar battery. 19/

In general, current production in the battery industry of East Germany is at a low technological level compared with production in the industry of the USSR, with many hand operations, poor designs, and inferior materials resulting in low productivity and poor products.

C. Other Countries.

1. Organization.

a. Bulgaria. 20/

The battery industry of Bulgaria is subordinate to the Ministry of Heavy Industry (Ministerstvo na Tezhkata Promishlenost) and directly controlled by Elprom (Elektricheska Promishlenost), which is one of the administrations composing the machine-building industry.

b. Communist China. 21/

In Communist China the battery industry up to April 1956 was known to have been under the control of the Electric Equipment Industry Control Bureau of the First Ministry of the Machine Building Industry (Ti-i Chi-hsieh Kung-yeh). Since May-July 1956 the battery industry probably has been under the new Ministry of the Electrical Equipment Industry (Tien-chi Kung-yeh Fu).

c. Czechoslovakia. 22/

The Ministry of Heavy Engineering (Ministervstvo Tezkeho Strojirenstvi), through the Main Administration of Metal Goods (Hlavni Sprava Kovoveho Zbozi?), controls production of batteries in Czechoslovakia. Storage batteries are produced under the Prazska Akumulatorka National Corporation, and primary batteries are produced under the Bateria National Corporation. Both corporations are subordinate to the Main Administration of Metal Goods.

d. Hungary. 23/

The battery industry of Hungary is subordinate to the Ministry of the Metallurgy and Machine Industry (Koho es Getipari Ministerium). In the office of the First Vice-Minister of this Ministry is the Electrical Industry Management, which is believed to exercise direct control of the battery industry.

e. Poland. 24/

The Central Administration of the Cable Industry (Centralny Zarzad Przemyslu Kablowego) of the Ministry of Heavy Industry

(Ministerstwo Przemyslu Ciezkiego) is the controlling organization for the battery industry of Poland.

f. Rumania. 25/

The Ministry of Heavy Industry (Ministerul Industrei Metalurgice si Constructii de Masini) supervises the battery industry of Rumania. There may be a Main Administration of Electric Power and Electrotechnical Industry (Energiei Electrice si Industriei Electro-Tehnica) formed from the former ministry of that name which directly controls battery production.

2. History and Technology.

a. European Satellites.* 26/

Bulgaria had almost no battery industry before World War II but has organized an industry of modest size from small privately owned facilities since the war. The battery industry of Bulgaria, however, has expanded slowly relative to the average country of the Sino-Soviet Bloc and has remained very small. In Rumania, where the battery industry before World War II apparently was established better than in Bulgaria, the industry has expanded rapidly since World War II.

In Hungary, Poland, and Czechoslovakia the prewar industries were well established, most of the producing firms apparently having been founded and owned by parent firms in Germany. The Tudor firm was especially active in Hungary and Poland. Hungary has the oldest industry, dating from 1890, whereas Poland and Czechoslovakia established their industries during the 1920's and 1930's. Since World War II, expansion of the battery industries of the European Satellites has been modest in terms of new investment. Because of the increased utilization of existing facilities, however, rates of growth of production during the postwar years have been substantial.

In Bulgaria, Czechoslovakia, Hungary, Poland, and Rumania the battery industries emerged from World War II almost undamaged. The USSR drew heavily on their production of batteries immediately after the war and still imports from them.

Technology of these European Satellites is characterized by extensive hand operations, inferior raw materials, old plant equipment, and prewar techniques. All of them rank somewhat below

---

* For information on the history and technology of the battery industry of East Germany, see B, 2, above.

East Germany in the level of technology and productivity, with the possible exception of Hungary. In technological proficiency, these European Satellites fall in the following order: Hungary, Czechoslovakia, Poland, Rumania, and Bulgaria. Albania has no battery industry.

Scientific research institutes operate in these Satellites to improve the operating technique of the plants and to improve existing products in minor ways. There is no evidence of a research and development program in the new areas of electrochemical development. The USSR apparently is the source for whatever new technology is adopted, although East Germany also may contribute. Hungary and Rumania have done work in the miniaturization of batteries for communications, measuring instruments, and miner's lamps. This development represents primarily the effort of the Satellites to design less expensive batteries through reducing material requirements rather than an attempt to design new batteries for new applications.

b. Communist China. 27/

Like the rest of the Chinese electrotechnical industry, the battery industry in China was established by foreigners during the 1920's and 1930's. US and European firms concentrated in Shanghai, and the Japanese established the industry in Manchuria.

After the techniques of production were introduced, many family-sized operations were undertaken by the Chinese, especially in the primary battery field, concentrating on production of flashlight cells. A US manufacturer who owned a branch plant in Shanghai before World War II estimated that there were more than 100 producers of flashlight cells in China at that time, concentrated primarily in the area around Canton. The products of these firms were very poor, having about one-sixth the life of a comparable US product. As might be expected, the prewar industry utilized hand labor for every operation in which machinery could possibly be eliminated.

Since the advent of the Chinese Communists in 1949, the state has taken over the large plants and gradually has eliminated the small private plants by amalgamating and nationalizing them. There are still, however, a considerable number of small plants producing small quantities of dry cells for civilian consumption in flashlights and radios. Again, as might be expected, the technological level has risen as the state has introduced new investment and foreign technicians into the industry. Another positive factor was the help extended to Nationalist China by US manufacturers after World War II. The insistence, however, on maintaining the historically conceived custom of producing both primary and storage batteries at the same location has made the rationalization of production processes more difficult than in the more backward of the European Satellites, such as Bulgaria and Rumania.*

Evidence of the poor technology in existence in Communist China today is a technical evaluation of a flashlight dry cell produced in Canton. The cell is an attempted copy of the US "Ray-O-Vac" flashlight cell, but the poor quality of raw materials and workmanship exhibited in its construction produced a battery of inferior quality.

It is estimated that the level of technology in the battery industry of Communist China is today no better and probably worse than the least developed of the European Satellites. With the advent of general investment in industry, however, it is predicted that new facilities will soon be constructed which will compare favorably with, and may even surpass, any now existing in the USSR. The Chinese do have the advantage of starting from scratch with little fixed investment to hinder modernization.

III. Production.

A. Magnitude and Growth.

The estimated value of production of batteries in the Sino-Soviet Bloc for selected years, 1938-63, is shown in Table 1** and for 1946-63 in the accompanying chart, Figure 2.*** The level of production prevailing before World War II was exceeded in 1946, primarily because the USSR expanded its production from the prewar level during and immediately following the war. Bulgaria, Hungary, and Rumania also equaled or exceeded their prewar levels of production by 1946. The other Bloc countries, except East Germany, regained their prewar levels of production by 1948, East Germany did not recover until 1949. The annual value of production in the Sino-Soviet Bloc doubled between 1946 and 1950, more than tripled between 1950 and 1957, and is expected to increase approximately two and one-half times between 1957 and 1963.

---

* The productive processes of the two types of batteries have no common operations and, therefore, afford no savings by joint production. In fact, hinderances develop when both types are produced in the same shop. Other members of the Sino-Soviet Bloc also produce a small quantity of batteries in a similar manner, but the plants are separated physically, although remaining under a common management.

** Appendix A, p. 28, below.

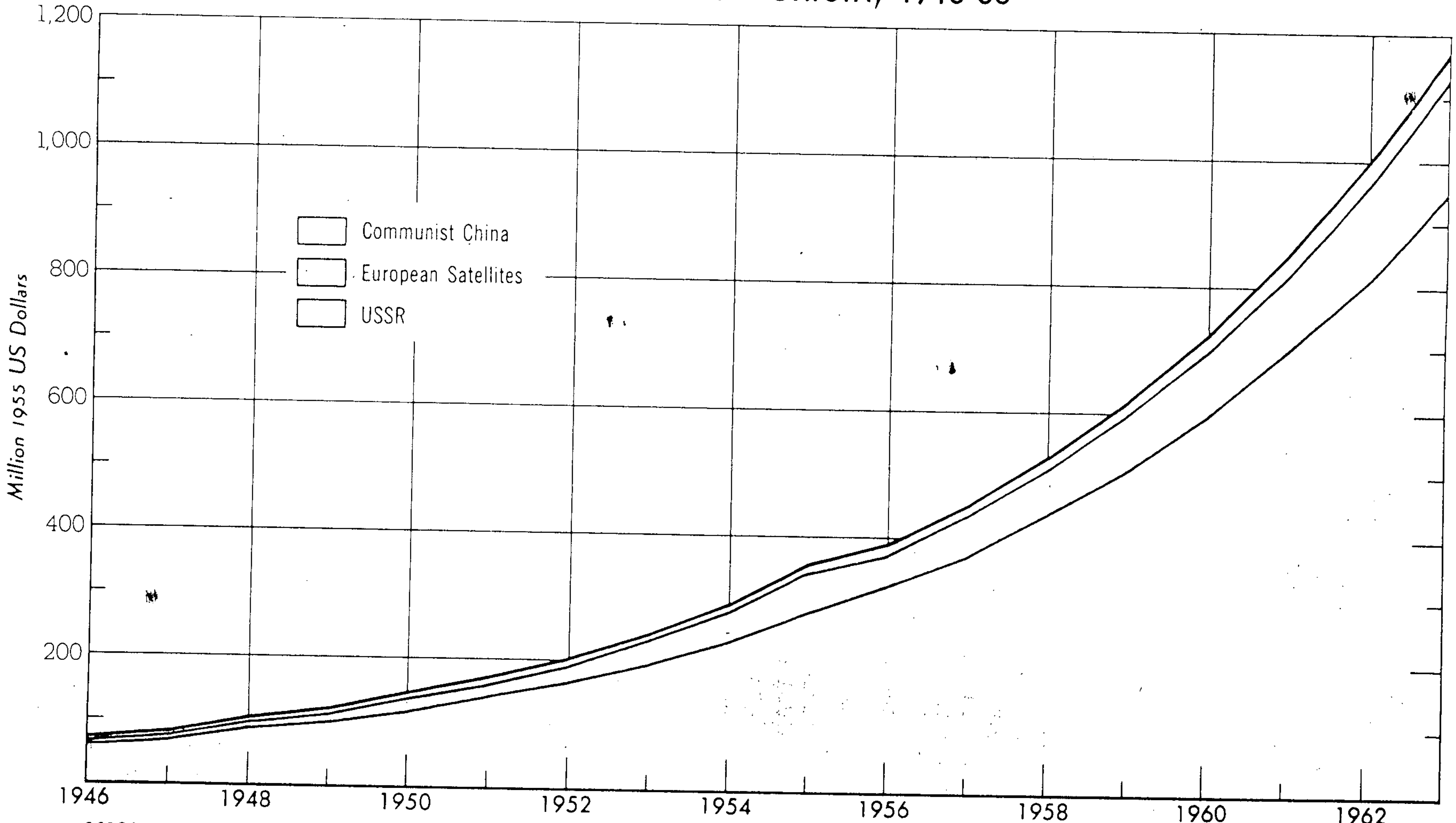
*** Following p. 14.

~~SECRET~~

Figure 2

SINO-SOVIET BLOC

ESTIMATED VALUE OF PRODUCTION OF ELECTRIC BATTERIES BY AREA OF ORIGIN, 1946-63



26382 2-58

~~SECRET~~

The annual value of production of batteries in the Sino-Soviet Bloc during 1957 was $449 million, of which the USSR contributed $373 million, or more than 80 percent of the total. Production of batteries in the Bloc in 1957 almost equaled the $453,472,000 value of batteries produced in the US in 1954. In 1947, production by the Bloc represented only 22 percent of production by the US. 28/

Before World War II the USSR produced about two-thirds of the value of production of the areas now included in the Sino-Soviet Bloc. Since the war the USSR has consistently contributed about four-fifths of the total value of production by the Bloc. In 1957, East Germany was a poor second with about 7 percent. The other Bloc countries in order by value of production were Communist China, Poland, Czechoslovakia, Hungary, Rumania, and Bulgaria. Only Hungary and Poland suffered lower annual production in 1956 than in 1955. In 1956, production in Hungary dropped to an estimated 60 percent of the level of production in 1955, and Poland produced 83 percent of the value of batteries produced in 1955. In 1957, the battery industry of Hungary was the only one in the Bloc to produce less than in 1956. Production of batteries in Hungary in 1957 is estimated to have been about 54 percent of that in 1955.

Indexes of the estimated value of production of batteries in each of the countries of the Sino-Soviet Bloc is shown in Table 2* and in the accompanying chart, Figure 3.** The average annual rate of increase of the value of production of batteries in the entire Bloc between 1950 and 1957 was about 18 percent. In the US the comparable rate of increase was less than 3 percent*** between 1947 and 1954. 29/ The USSR obtained an 18-percent average annual rate of increase between 1950 and 1957. East Germany obtained the highest rate of increase, whereas Hungary had the lowest. From 1950 to 1955, however, Hungary had the highest rate of increase, about 28.6 percent per year. Ranked by the average annual rates of increase obtained between 1950 and 1957, the countries of the Bloc are East Germany, Rumania, Communist China, the USSR, Bulgaria, Poland, Czechoslovakia, and Hungary. The average annual rate of increase of production of batteries is expected to be somewhat lower between 1957 and 1963 than it was between 1950 and 1957. The future increase of production apparently is to be obtained primarily by increased mechanization, specialization, and automation in the USSR, Czechoslovakia, Poland, and East Germany and primarily by new plant construction in the other European Satellites and China.

* Appendix A, p. 29, below.
** Following p. 16.
*** In current prices.

The estimated volume of production of storage batteries in the Sino-Soviet Bloc is shown in Table 3,* the estimated value is shown in Table 4,** and the estimated value of production of batteries, by type of product, are shown in the accompanying chart, Figure 4.*** The USSR produced about 85 percent of the value of storage batteries produced by the Bloc in 1956. The estimated volume of production of primary batteries in the Sino-Soviet Bloc is shown in Table 5,**** and the estimated value of production is shown in Table 6† and in Figure 4.*** About 78 percent of the primary batteries were contributed by the USSR in 1956.

B. Composition. 30/

The estimated value of production of batteries in the Sino-Soviet Bloc, by type of product, is shown in Table 7†† and in Figure 4.*** Of the value of production of batteries in the Bloc, storage batteries accounted for 73 percent and primary batteries for 27 percent. In the US in 1954 the percentages were 74 percent for storage batteries and 26 percent for primary batteries. In 1947, storage batteries accounted for 79 percent and primary batteries for 21 percent of the value of production of batteries in the US.

Although the composition of production of batteries is amazingly similar in the Sino-Soviet Bloc and in the US with respect to storage and primary batteries, there are significant differences in the sizes of subcategories within the over-all categories of storage and primary batteries. Perhaps the most outstanding contrast is the large proportion of production of batteries which is devoted to alkaline batteries in the Bloc, 21 percent, and the small proportion represented by alkaline batteries in the US, about 5 percent. Within the category of alkaline batteries are nickel-cadmium alkaline storage batteries, which represent about 12 percent of production of batteries in the Bloc and more than one-half of the category of alkaline batteries, whereas in the US less than 0.5 percent of production of batteries is composed of nickel-cadimum storage batteries.†††

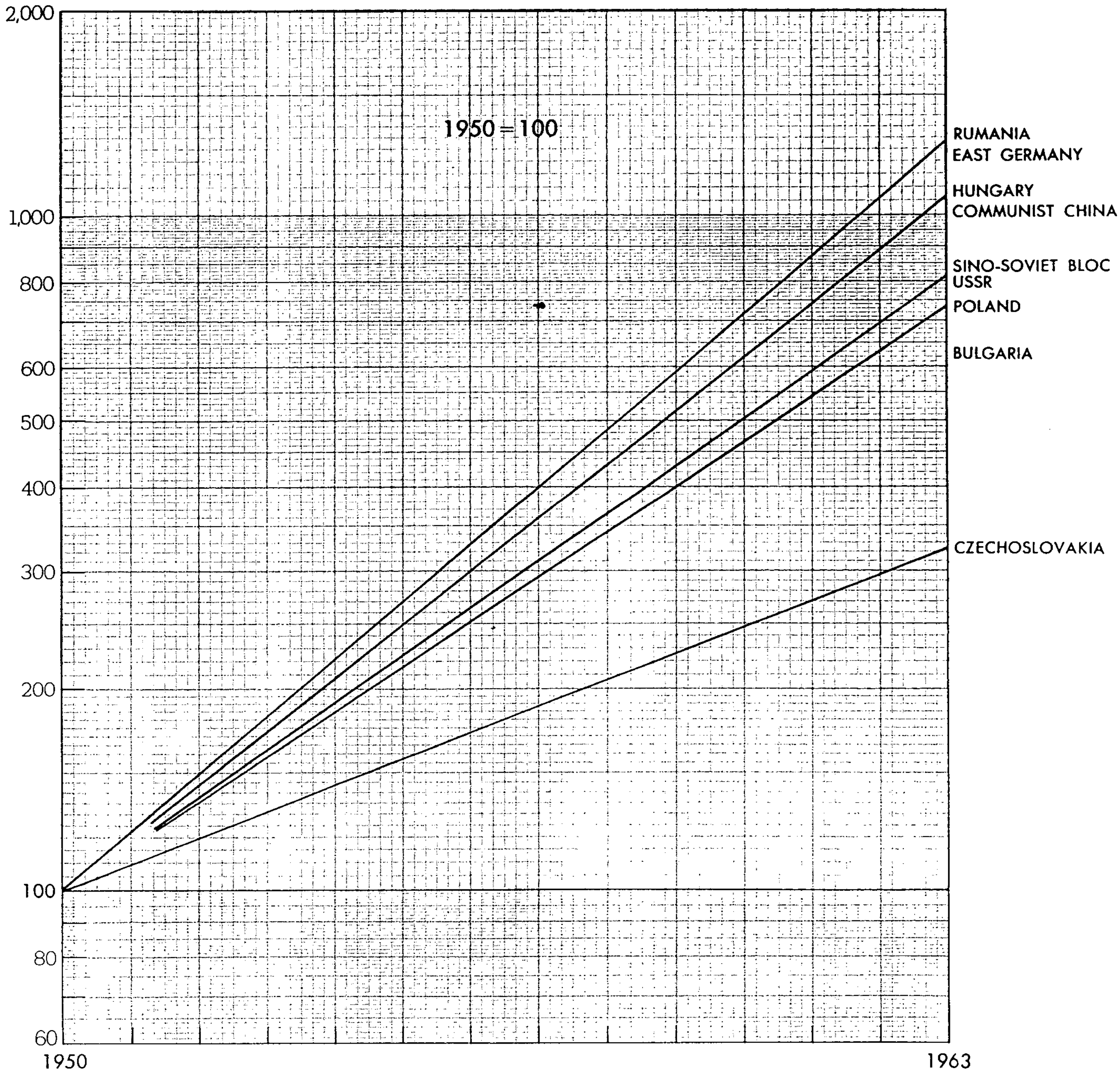
* Appendix A, p. 30, below.
** Appendix A, p. 31, below.
*** Following p. 16.
**** Appendix A, p. 32, below.
† Appendix A, p. 33, below.
†† Appendix A, p. 34, below.
††† The applications of nickel-cadmium alkaline batteries within the Sino-Soviet Bloc are primarily as a power source for radio transmitters and receivers, miners' lamps, and control systems for guided missiles and other weapons. The nickel-iron /footnote continued on p. 17/

[redacted]

Figure 3

SINO-SOVIET BLOC*

ESTIMATED INDEX OF THE VALUE OF PRODUCTION OF ELECTRIC BATTERIES, 1950 AND 1963



26383 2-58

[redacted]

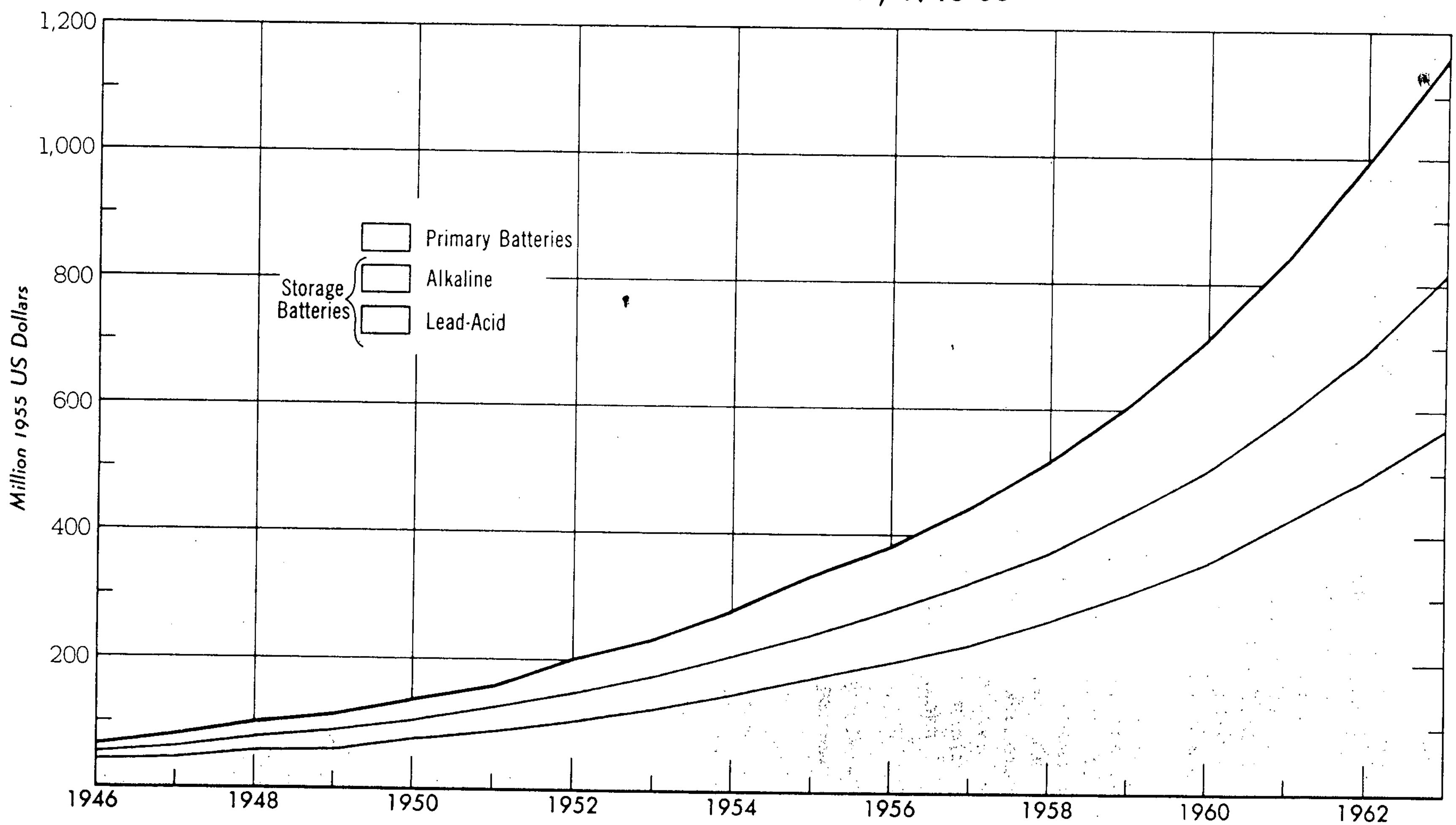
*Albania Negligible

~~SECRET~~

Figure 4

SINO-SOVIET BLOC

ESTIMATED VALUE OF PRODUCTION OF ELECTRIC BATTERIES BY TYPE OF BATTERY, 1946-63



26384 2-58

~~SECRET~~

Another significant difference is that the Bloc allocates to the motive power application almost twice as much of its production of batteries as does the US -- 19 percent for the Bloc and about 10 percent for the US. The relatively heavy emphasis of the USSR on production of submarine batteries is believed to account for most of this difference. More than 10 percent of total production of batteries in the Bloc is allocated to submarine propulsion batteries. In addition, 7 percent of Bloc production is allocated to production of batteries for the propulsion of electric torpedoes.

The largest category for both the Sino-Soviet Bloc and the US consists of SLI batteries. The US allocates about 57 percent of its total production to this category, whereas the Bloc allocates about one-half as much, or 30 percent. Furthermore, in the US almost the entire category of SLI batteries is for automotive purposes, whereas in the Bloc about 70 percent of SLI batteries is of the automotive type. One other important difference is that SLI batteries for aircraft represent only 1 percent of production in the US but almost 4 percent in the Bloc.

The allocation to stationary storage batteries is very similar in the US and the Sino-Soviet Bloc, representing about 3 percent of the total production of batteries in each country.

The percentage allocations to production of the radio and flashlight battery subcategories of primary batteries in the US are less than those for the same categories in the Sino-Soviet Bloc, whereas for other primary batteries the reverse is true. Radio batteries represent 10.3 percent of production in the Bloc and 7.8 percent in the US, flashlight batteries 12.6 percent of production in the Bloc and 11.8 percent in the US, and other primary batteries (primarily general-purpose batteries) 3.8 percent of production in the Bloc and 6.3 percent in the US.

---

alkaline batteries are primarily used for motive power for industrial trucks and mine locomotives. Stationary batteries of this type are used for emergency power, communications systems, and railroad diesel starting batteries. It was deemed appropriate that alkaline batteries be listed separately from the categories representing lead-acid batteries because of the much higher cost per unit of weight of alkaline batteries and because of the emphasis placed on their manufacture within the Bloc.

IV. Trade. 31/

A. USSR.

The USSR imports a larger quantity of batteries than any other country of the Sino-Soviet Bloc. Principal suppliers of the USSR are Sweden, Austria, East Germany, and Hungary. About one-half of the Swedish exports are of alkaline batteries. East Germany supplies heavy types of lead-acid batteries, radio dry batteries, and silver-zinc reserve batteries.* Hungary exports alkaline batteries to the USSR.

Exports of batteries by the USSR are also the largest in the Sino-Soviet Bloc, although the USSR is estimated to be a net importer. Most of the Soviet exports of batteries go to Communist China. Among the European Satellites, Albania ranks first as an importer of Soviet batteries, primarily automotive SLI batteries, with Bulgaria and Rumania sharing the remainder equally. Since 1955 the USSR has sold small quantities of batteries to Greece, Argentina, and North Vietnam. North Korea and Egypt began to import from the USSR in about 1950.

Imports of batteries have not been a significant proportion of the total supply of batteries to the USSR since World War II, probably never amounting to more than 5 percent of the total supply and probably less than that since 1950. It is estimated that both imports and exports of batteries by the USSR have declined absolutely since 1950.

B. Albania.

Because domestic production of batteries is zero, Albania imports its entire supply of batteries. The USSR was almost the sole supplier until about 1951, when East Germany, Czechoslovakia, Poland, and Hungary apparently began to export batteries to Albania. Albania imports only the most common types of batteries, such as automotive SLI batteries and flashlight dry cells, and has requirements which are a negligible proportion of the production of the supplying countries.

C. Bulgaria.

Bulgaria has been a net importer of batteries since World War II. In 1955, however, it began to export small quantities of batteries to Syria and Rumania. In 1957 it also exported to Turkey,

* Silver-zinc batteries are under development in the US as power sources for electronic systems in guided missiles. A similar use may be imputed to the silver-zinc batteries going to the USSR.

and at least one-fifth of its total production was to have been exported. It is possible that Bulgaria is now a net exporter by a small margin, although a considerable amount of re-exporting probably is taking place.

Through 1955, Bulgaria received imports of batteries principally from the USSR and East Germany, but Czechoslovakia was by far the largest supplier of batteries to Bulgaria in 1956.

D. Communist China.

Communist China, a net importer of batteries, is dependent on the USSR for most of its imports of batteries, although Czechoslovakia, Hungary, and West Germany also have contributed significantly. The requirements of China are principally for the heavy types of storage batteries, especially the military types for tanks, submarines, and aircraft.

Beginning in about 1956, Communist China has advertised widely its flashlight dry cells for sale over most of Southeast Asia. China has made a few small sales to Burma and Borneo and perhaps to Egypt through Hong Kong. These sales are believed to be for prestige value alone and do not reflect an abundant domestic supply.

E. Czechoslovakia.

No imports of batteries by Czechoslovakia have been noted since World War II. Although the domestic industry is not large, Czechoslovakia supplies significant quantities of batteries to Communist China, Albania, and Bulgaria and supplies smaller quantities to Rumania, Turkey, and Egypt.

F. East Germany.

East Germany imports no batteries except a few special nickel-cadmium radio batteries from West Germany. On the other hand, it exports widely and in significant quantities. Immediately following World War II, East Germany was the prime supplier of the USSR, with perhaps 80 percent of its production going to the USSR. Since Soviet demands fell off rather abruptly in 1954, East Germany has exported more to Bulgaria, Albania, Poland, Hungary, Switzerland, and West Germany, although the USSR remains by far the largest consumer of East German batteries. In 1956 and 1957, Egypt received aircraft and vehicle batteries from East Germany. In 1956, other countries added to the list of importers from East Germany were Norway, Syria, Turkey, and India.

G. Hungary.

Hungary is a net exporter of batteries. The USSR, Communist China, Albania, and Poland are the principal recipients of Hungarian batteries, with Bulgaria and Turkey receiving only small amounts. Hungary does import batteries, however, from Sweden, West Germany, East Germany, and Poland. Sweden appears to be the primary supplier.

H. Poland.

Poland exports batteries to Albania, Hungary, Greece, and Turkey, although its imports of batteries are greater than its exports. East Germany long has supplied batteries to Poland, but more recently Hungary, the UK, and West Germany have become important sources of batteries for Poland. In 1955 and 1956, Poland probably relied more heavily on the West for battery imports than did any other country of the Sino-Soviet Bloc.

I. Rumania.

Rumania is a net importer of batteries and relies primarily on the USSR and Hungary for its imports. Czechoslovakia, Austria, Belgium, and West Germany export small quantities of batteries to Rumania.

V. Use Pattern and Requirements.

A. Use Pattern.

Most of the products of the battery industry are designed for specific uses. Accordingly, the use pattern of the industry has been determined from the known applications of the various categories of products and, where a category has more than one use, from an estimated priority allocation among end uses.

The principal uses of batteries are in (1) industry, including all batteries used as producer goods but omitting those used as components in the manufacture of final products; (2) civilian consumption, including batteries used as components of commodities for personal consumption; (3) power networks, including all batteries used for control and emergency standby pruposes; (4) communications networks, including all batteries used for voltage regulation and emergency standby purposes; (5) certain direct military end items, including multipurpose batteries which are used exclusively by the military.

The estimated distribution of batteries in the Sino-Soviet Bloc, as percentages of each type of battery, for the principal purposes listed above is shown in Table 8.*

Table 9** and the accompanying chart, Figure 5,*** show the estimated distribution of batteries in the Sino-Soviet Bloc in 1956 as percentages of total production. More than 40 percent of production of batteries was allocated to military uses, whereas only one-half as much, about one-fifth of the total, was allocated to civilian consumption. Industry consumed about one-quarter of the total production of batteries.

B. Requirements. 32/

The requirements**** of the Sino-Soviet Bloc for batteries are being met substantially except for batteries demanded for civilian consumption, particularly radio batteries. Apparently the shortage of radio batteries is most severe in absolute terms in the USSR, probably because the USSR has many more battery-powered radios than any of the Satellites or Communist China. The disproportion between the rates of production of battery-powered broadcast radio receivers and radio batteries apparently is planned because the production plans of both commodities have been fulfilled generally from 1950 through 1957. Soviet policymakers would seem to dictate that the public listen to their radios less than they would prefer.

Temporary shortages have been noted from time to time in military and industrial batteries although the cause of such shortages, which was almost invariably a lack of materials, particularly nonferrous metals, usually was overcome rapidly through imports and adjustments in allocations of both finished batteries and material imports.

Capacity appears to be adequate for present requirements in the Sino-Soviet Bloc as a whole. In the USSR, however, production appears to be at or near full capacity, whereas the European Satellites and Communist China, to a lesser degree, do not utilize their full capacities because of the chronic lack of raw materials.

* Appendix A, p. 36, below.
** Appendix A, p. 37, below.
*** Following p. 22.
**** Requirements are defined as actual orders for batteries.

VI. Inputs.

A. Labor.

Table 10* shows the estimated labor force of the battery industry of the Sino-Soviet Bloc in 1957. Productivity of the USSR is clearly superior to that of the other members of the Bloc, for the USSR contributes over four-fifths of the value of production of batteries in the Bloc, with only slightly more than one-half of the labor force employed by the battery industry of the Bloc.

B. Materials.

The estimated inputs of selected materials for production of batteries in the Sino-Soviet Bloc in 1956 is shown in Table 11.** The battery industry is a significant consumer of certain nonferrous metals such as cadmium, lead, and antimony. Other nonferrous metals of which the battery industry is a less important consumer are nickel and zinc. Negligible percentages of production of the other indicated material inputs were consumed by the battery industry in 1956.

VII. Capabilities, Limitations, and Intentions.

A. Capabilities.

All types of batteries required by the Sino-Soviet Bloc can be manufactured domestically. The Bloc is capable of manufacturing products of adequate quality for both military and civilian requirements. The technology of the Bloc, however, is inferior to that of the US, and its equipment is generally less modern and less efficient than equipment employed by the US. In particular, the Bloc has a severe deficiency of materials-handling equipment, thus reducing productivity, causing excess consumption of labor, and in some cases reducing the quality of the product. Craftsmanship in hand operations, however, appears to be as good as any in the West. This asset is usually nullified by poor materials, resulting from improperly controlled processing.

In research and development of batteries the Sino-Soviet Bloc has progressed nearly as far as most Western countries, although it is certainly far behind in improving the quality of the batteries in large-scale production. Nevertheless, the Bloc has developed and produces far more alkaline batteries than does the US. Western Europe, however, also produces alkaline batteries on a significant scale. The

---

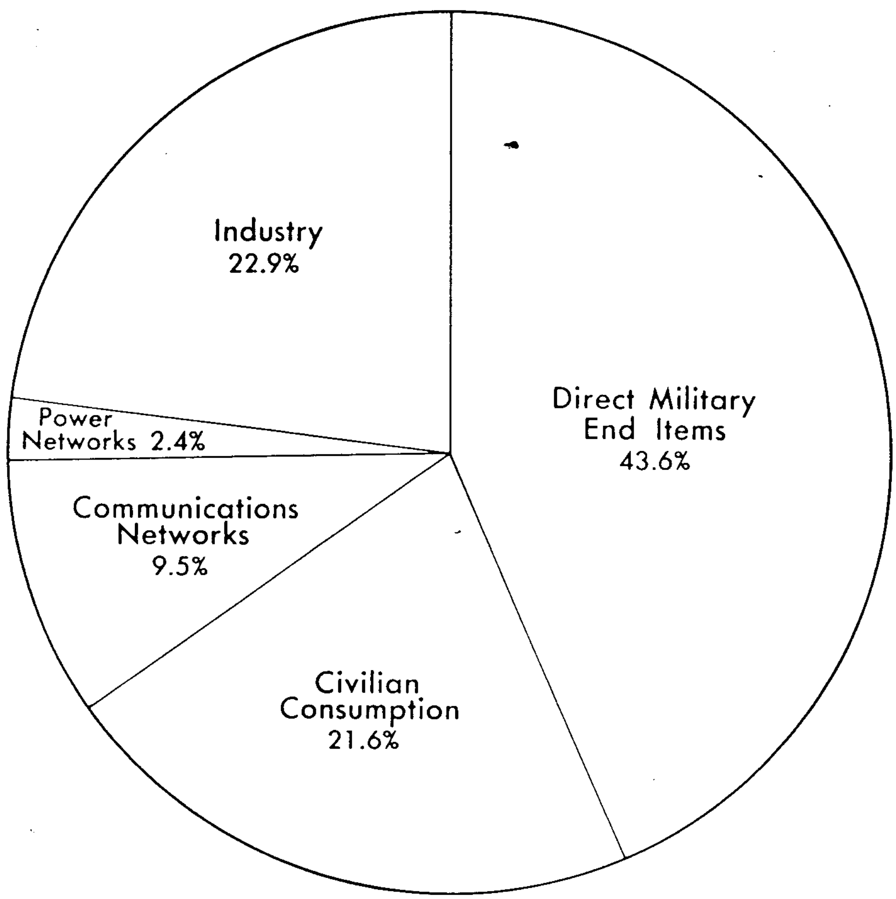
* Appendix A, p. 38, below.
** Appendix A, p. 39, below.

~~SECRET~~

Figure 5

SINO-SOVIET BLOC

ESTIMATED DISTRIBUTION OF ELECTRIC BATTERIES AS PERCENTAGES OF TOTAL PRODUCTION 1956



26385 2-58

~~SECRET~~

depth of experience with alkaline batteries, particularly those of the nickel-cadmium type, may afford the Bloc some advantage in developing batteries for military applications, such as power sources for guidance systems of guided missiles. In addition, East Germany especially has had long experience in the development and production of silver-zinc batteries which have military applications similar to those of the nickel-cadmium alkaline battery. On the whole, however, it does not appear that the Bloc has developed any new type of battery with which the research organizations of the US are not familiar.

Gains in reducing costs and increasing production to meet future requirements will be obtained by the Sino-Soviet Bloc because of the increasing integration and modernization of the battery industry of the Bloc. Such a development will produce specialization, standardization, and increased productivity of labor. The supply of producer goods for investment in the battery industry appears to be available in the foreseeable future.* In addition, with the possible conversion of Soviet submarines to nuclear power,** the requirements levied on the battery industry may be reduced significantly. At present the supply of nonferrous metals appears to be the limiting factor on production. The battery industry probably has the capacity to process more materials than are available. 35/

B. Limitations.

Although the Sino-Soviet Bloc does not yet depend heavily on imports of batteries to meet its requirements, the battery industry of the Bloc appears to be a high-cost industry relative to the battery industries of Western countries, primarily because the industry requires significant quantities of scarce nonferrous metals.*** Because of the heavy military requirements for batteries the Bloc has at present almost no choice except to pay the higher cost of domestic production, for the economic vulnerability of the Bloc would be even greater if dependence on foreign supply were to be initiated. In addition, there appears little likelihood of cheaper substitutes for conventional batteries being developed in the near future, although in the long run such substitutes may be developed.

---

* This statement is based on the plans of the battery industry of the USSR to re-equip with modern machinery in the near future. 33/

** Recent contacts with unidentified submarines (probably Soviet submarines) point toward the possible existence of improved propulsion systems. These systems may be a nuclear power system or may be based on improved submarine batteries. 34/

*** Other significant factors are obsolete equipment, backward technology, and high transportation costs.

Another closely related vulnerability is of an organizational character and is one which the USSR may remedy with its plan of decentralization. Because a great proportion of the battery industry of the USSR was established during or immediately following World War II, manufacturing facilities were set up hurriedly, and in some cases little thought was given to the rational specialization of plants and the geographic relationships of consumers and suppliers. There are, therefore, higher costs of transportation and higher manufacturing costs to the industry than there would be under a more rational organization. The most important result of the long hauls from manufacturer to consumer is that batteries arrive at their distant destinations with their useful lives greatly depleted through handling and elapsed time, even though inspection at the factory indicated that the batteries were entirely satisfactory. Additionally, destruction of transport facilities could severely impair the supply of batteries.

C. Intentions.

The Sino-Soviet Bloc intends to modernize its battery industry as rapidly as possible. The new automatic equipment developed recently is being adopted primarily in the USSR, and the Soviet plan is to intensify this effort during 1958-60 and presumably to continue the program beyond 1960. 36/ Evidently the chief reason for this decision is that the quality of products as well as the volume of production rises with the installation of new equipment. Other possible gains will be conservation of manpower and raw materials and the ability to produce new designs which could not be manufactured with present equipment. In the more developed countries such as the USSR, East Germany, and Czechoslovakia the investment policy appears to be to replace old capital equipment with new equipment instead of merely adding the new. In the other European Satellites and in Communist China the policy appears to be to build new plants and to add on to existing plants without discontinuing the service of obsolete equipment.*

As previously mentioned the USSR intends to solve some of its problems in transportation and specialization by decentralized administration. These plans may not be feasible for a large part of the battery industry, because of the expense of moving specialized machinery and equipment. The probable solution lies in gradually relocating facilities as the bulk of the older equipment is replaced.

The intention to be independent of Free World sources of supply of end products and raw materials largely has been accomplished -- more so for the manufacture of end products than for the supply of raw

* The conclusions concerning investment policy were derived from plant studies and from Soviet policy statements concerning investment. 37/

materials. Another intention which partly has been accomplished is the standardization of battery materials and end products. Although far from completed, the movement toward standardization has resulted in the adoption by the European Satellites and Communist China of many Soviet standards. Further plans toward this end are being made and carried out through CEMA (Council for Mutual Economic Assistance).* 38/

* For references to individual plants which have adopted Soviet standards, see Appendix B.

APPENDIX A

STATISTICAL TABLES

[p. 26 blank]

Table 1

Estimated Value of Production of Electric Batteries
in the Sino-Soviet Bloc a/
1938 and 1946-63

Year	USSR	Bulgaria	Communist China b/	Czecho-slovakia	East Germany	Hungary	Poland	Rumania	Total European Satellites	Total Bloc	Percentage of Total Produced by the USSR
	Million 1955 US $										
1938	26	Negligible	1.1	2.8	4.2 c/	0.7	3.6	0.5	12	39	66.7
1946	59	0.2	0.5	2.5	0.8	1.1	1.5	0.5	7	66	89.4
1947	70	0.2	0.9	2.8	1.6	1.4	3.1	0.6	10	81	86.4
1948	84	0.2	2.7	3.2	4.0	1.5	3.9	0.6	13	100	84.0
1949	99	0.3	3.4	3.5	5.7	1.8	3.7	0.7	16	118	83.9
1950	117	0.3	4.0	5.0	8.0	2.1	4.5	0.7	21	142	82.4
1951	139	0.3	4.8	5.5	8.6	2.4	5.5	0.7	23	167	83.2
1952	165	0.4	5.7	6.1	11.1	2.9	6.8	1.0	28	199	82.9
1953	195	0.4	6.8	6.8	14.7	3.9	8.3	1.4	36	237	82.3
1954	231	0.5	8.1	7.5	21.3	5.4	9.7	1.9	46	285	81.1
1955	276	0.5	9.7	8.3	22.8	7.4	11.1	2.2	52	338	81.7
1956	320	0.6	11.5	9.1	27.4	4.4	9.2	2.6	53	385	83.2
1957	373	0.9	13.9	9.9	32.8	4.0	11.0	3.1	62	449	83.1
1958	433	1.0	16.5	10.8	39.4	5.2	13.3	3.8	74	523	82.8
1959	504	1.1	19.8	11.8	47.3	7.0	16.0	4.5	88	612	82.4
1960	587	1.3	23.5	12.8	56.7	9.4	19.2	5.4	105	715	82.1
1961	687	1.5	28.2	13.9	68.1	12.5	23.1	6.5	126	841	81.7
1962	802	1.6	33.6	15.2	81.7	16.7	27.7	7.7	151	986	81.3
1963	939	1.9	40.2	16.4	98.1	22.4	33.3	9.3	181	1,161	80.9
	Percent										
Percentage of total Bloc production in 1957	83.1	0.2	3.1	2.2	7.3	0.9	2.5	0.7	13.8	100.0	

a. Because of rounding, figures may not add to the totals shown.
b. Figures for pre-Communist China (1938-48) are for approximately the same area as those for Communist China (1949-63).
c. The figure for estimated production in East Germany in 1938 is for the same area as the figures for postwar East Germany.

Table 2

Indexes of the Estimated Value of Production of Electric Batteries in the Sino-Soviet Bloc, by Year 1938 and 1946-63

Year	USSR	Bulgaria	Communist China a/	Czecho-slovakia	East Germany	Hungary	Poland	Rumania	Total Bloc
	1950 = 100								
1938	22	10	28	56	52 b/	33	80	69	27
1946	50	66	12	50	10	52	33	69	46
1947	60	73	22	56	20	67	69	75	57
1948	72	81	68	64	50	71	87	83	70
1949	85	90	85	70	71	86	82	89	83
1950	100	100	100	100	100	100	100	100	100
1951	119	111	120	110	107	114	122	107	118
1952	141	124	142	122	139	138	151	135	140
1953	167	137	170	136	183	186	184	193	167
1954	197	152	202	150	266	257	216	252	201
1955	236	170	242	166	285	352	247	300	238
1956	274	192	288	182	342	210	204	357	271
1957	319	281	348	198	410	190	244	428	316
1958	370	322	412	216	492	248	296	514	368
1959	431	368	495	236	591	333	356	617	431
1960	502	419	588	256	709	448	427	741	504
1961	587	478	705	278	851	595	513	889	592
1962	685	546	840	304	1,021	795	616	1,066	694
1963	803	624	1,005	328	1,226	1,067	740	1,280	818
	Percent								
Annual average rate of growth in 1950-57	18.0	15.9	19.5	10.2	23.3	9.6	13.6	23.1	17.9

a. Figures for pre-Communist China (1938-48) are for approximately the same area as those for Communist China (1949-63).
b. The figure for estimated production in East Germany in 1938 is for the same area as the figures for postwar East Germany.

Table 3

Estimated Volume of Production of Storage Batteries in the Sino-Soviet Bloc a/
1938 and 1946-63

Year	USSR	Bulgaria	Communist China b/	Czecho-slovakia	East Germany	Hungary	Poland	Rumania	Total Bloc
	Thousand Metric Tons								
1938	27	Negligible	0.7	2.0	4.2 c/	0.8	1.8	0.6	37
1946	60	0.2	0.3	1.7	0.8	1.3	1.3	0.6	66
1947	71	0.3	0.6	2.0	1.6	1.6	1.9	0.7	80
1948	83	0.3	1.9	2.3	4.0	1.8	3.7	0.7	98
1949	96	0.3	2.5	2.6	5.6	2.2	3.1	0.8	113
1950	111	0.4	3.0	3.0	7.9	2.6	3.8	0.9	133
1951	130	0.4	3.5	3.4	8.5	3.0	4.8	1.0	155
1952	152	0.4	4.2	3.8	11.0	3.7	6.0	1.3	182
1953	178	0.5	4.9	4.2	14.5	4.9	7.6	1.9	216
1954	207	0.6	5.8	4.7	21.1	6.5	8.7	2.6	257
1955	241	0.6	6.9	5.3	22.6	8.7	9.5	3.1	298
1956	274	0.7	8.2	5.8	27.1	5.2	8.9	3.7	334
1957	312	1.2	9.7	6.4	32.5	4.7	10.8	4.5	382
1958	353	1.4	11.5	7.0	39.0	6.1	13.0	5.4	436
1959	402	1.6	13.7	7.7	46.9	7.9	15.7	6.5	502
1960	457	1.8	16.2	8.5	56.2	10.4	19.0	7.8	577
1961	520	2.1	19.2	9.4	67.5	13.4	22.9	9.3	664
1962	594	2.4	22.7	10.3	81.0	17.5	27.5	11.2	767
1963	677	2.8	26.9	11.3	97.2	22.7	33.2	13.4	884
	Percent								
Percentage of total Bloc production in 1957	81.7	0.3	2.5	1.7	8.5	1.2	2.8	1.2	100.0

a. Because of rounding, figures may not add to the totals shown.
b. Figures for pre-Communist China (1938-48) are for approximately the same area as those for Communist China (1949-63).
c. The figure for estimated production in East Germany in 1938 is for the same area as the figures for postwar East Germany.

Table 4

Estimated Value of Production of Storage Batteries in the Sino-Soviet Bloc a/ 1938 and 1946-63

Year	USSR	Bulgaria	Communist China b/	Czecho-slovakia	East Germany	Hungary	Poland	Rumania	Total Bloc
	Million 1955 US $								
1938	23	Negligible	0.4	1.3	3.5 c/	0.5	1.0	0.3	30
1946	50	0.1	0.2	1.1	0.7	0.8	0.7	0.3	54
1947	59	0.1	0.3	1.3	1.3	1.0	1.1	0.4	65
1948	70	0.1	1.0	1.5	3.3	1.1	2.1	0.4	80
1949	81	0.2	1.3	1.7	4.7	1.3	1.7	0.5	92
1950	95	0.2	1.5	2.0	6.6	1.6	2.1	0.5	110
1951	111	0.2	1.8	2.2	7.1	1.8	2.7	0.5	217
1952	131	0.2	2.1	2.5	9.2	2.2	3.4	0.7	151
1953	152	0.2	2.5	2.8	12.1	2.9	4.3	1.1	178
1954	178	0.3	2.9	3.1	17.5	3.9	4.9	1.5	212
1955	209	0.3	3.5	3.5	18.8	5.2	5.3	1.8	247
1956	241	0.4	4.1	3.9	22.6	3.1	5.0	2.1	282
1957	278	0.6	4.9	4.3	27.1	2.8	6.0	2.5	326
1958	320	0.7	5.8	4.7	32.5	3.6	7.3	3.1	378
1959	370	0.8	6.9	5.2	39.0	4.7	8.8	3.7	439
1960	427	0.9	8.1	5.7	46.8	6.2	10.6	4.4	510
1961	496	1.1	9.6	6.2	56.2	8.0	12.8	5.3	595
1962	575	1.2	11.4	6.9	67.4	10.5	15.4	6.3	694
1963	669	1.4	13.5	7.5	80.9	13.6	18.6	7.6	812
	Percent								
Percentage of total Bloc production in 1956	85.4	0.1	1.5	1.4	8.0	1.1	1.8	0.7	100.0

a. Because of rounding, figures may not add to the totals shown.
b. Figures for pre-Communist China (1938-48) are for approximately the same area as those for Communist China (1949-63).
c. The figure for estimated production in East Germany in 1938 is for the same area as the figures for postwar East Germany.

Table 5

Estimated Volume of Production of Primary Batteries
in the Sino-Soviet Bloc a/
1938 and 1946-63

Year	USSR	Bulgaria	Communist China b/	Czecho-slovakia	East Germany	Hungary	Poland	Rumania	Total Bloc
	Thousand Metric Tons								
1938	4	Negligible	0.9	1.5	0.8 c/	0.3	3.4	0.2	11
1946	11	0.1	0.4	1.4	0.2	0.4	0.9	0.2	15
1947	13	0.1	0.8	1.5	0.3	0.4	2.2	0.2	18
1948	17	0.1	2.1	1.7	0.8	0.5	2.0	0.2	24
1949	21	0.1	2.6	1.8	1.1	0.5	2.2	0.3	30
1950	26	0.1	3.1	3.0	1.5	0.6	2.6	0.3	37
1951	33	0.1	3.7	3.3	1.6	0.6	3.1	0.3	46
1952	41	0.2	4.5	3.6	2.1	0.8	3.8	0.4	56
1953	50	0.2	5.4	4.0	2.8	1.1	4.5	0.4	68
1954	63	0.2	6.5	4.4	4.0	1.6	5.4	0.5	86
1955	79	0.2	7.8	4.8	4.3	2.3	6.4	0.5	105
1956	94	0.2	9.3	5.2	5.1	1.4	4.7	0.6	120
1957	112	0.3	11.2	5.6	6.2	1.2	5.6	0.7	143
1958	133	0.3	13.4	6.1	7.4	1.7	6.7	0.9	170
1959	159	0.3	16.1	6.6	8.9	2.4	8.0	1.0	202
1960	189	0.4	19.3	7.1	10.7	3.3	9.6	1.3	241
1961	225	0.4	23.2	7.7	12.8	4.7	11.5	1.5	287
1962	268	0.4	27.8	8.3	15.4	6.5	13.7	1.8	342
1963	320	0.5	33.4	8.9	18.4	9.2	16.4	2.2	409
	Percent								
Percentage of total Bloc production in 1957	78.4	0.2	7.8	3.9	4.3	0.8	3.9	0.5	100.0

a. Because of rounding, figures may not add to the totals shown.
b. Figures for pre-Communist China (1938-48) are for approximately the same area as those for Communist China (1949-63).
c. The figure for estimated production in East Germany in 1938 is for the same area as the figures for postwar East Germany.

Table 6

Estimated Value of Production of Primary Batteries in the Sino-Soviet Bloc a/ 1938 and 1946-63

Year	USSR	Bulgaria	Communist China b/	Czecho-slovakia	East Germany	Hungary	Poland	Rumania	Total Bloc
	Million 1955 US $								
1938	3	Negligible	0.7	1.5	0.7 c/	0.2	2.6	0.2	9
1946	9	0.1	0.3	1.4	0.1	0.3	0.8	0.2	12
1947	11	0.1	0.6	1.5	0.3	0.4	2.0	0.2	16
1948	14	0.1	1.7	1.7	0.7	0.4	1.8	0.2	21
1949	18	0.1	2.1	1.8	1.0	0.5	2.0	0.2	26
1950	22	0.1	2.5	3.0	1.4	0.5	2.4	0.2	32
1951	28	0.1	3.0	3.3	1.5	0.6	2.8	0.2	40
1952	34	0.2	3.6	3.6	1.9	0.7	3.4	0.3	48
1953	43	0.2	4.3	4.0	2.6	1.0	4.0	0.3	59
1954	53	0.2	5.2	4.4	3.8	1.5	4.8	0.4	73
1955	67	0.2	6.2	4.8	4.0	2.2	5.8	0.4	91
1956	79	0.2	7.4	5.2	4.8	1.3	4.2	0.5	103
1957	95	0.3	9.0	5.6	5.7	1.2	5.0	0.6	122
1958	113	0.3	10.7	6.1	6.9	1.6	6.0	0.7	145
1959	134	0.3	12.9	6.6	8.3	2.3	7.2	0.8	172
1960	160	0.4	15.4	7.1	9.9	3.2	8.6	1.0	206
1961	191	0.4	18.6	7.7	11.9	4.5	10.3	1.2	246
1962	227	0.4	22.2	8.3	14.3	6.2	12.3	1.4	292
1963	270	0.5	26.7	8.9	17.2	8.8	14.7	1.7	348
	Percent								
Percentage of total Bloc production in 1956	76.9	0.2	7.2	5.1	4.7	1.3	4.1	0.5	100.0

a. Because of rounding, figures may not add to the totals shown.
b. Figures for pre-Communist China (1938-48) are for approximately the same area as those for Communist China (1949-63).
c. The figure for estimated production in East Germany in 1938 is for the same area as the figures for postwar East Germany.

Table 7

Estimated Value of Production of Electric Batteries
in the Sino-Soviet Bloc, by Type a/*
1956

Type of Battery	Value (Thousand 1955 US $) USSR	Bulgaria	Communist China	Czechoslovakia	East Germany	Hungary	Poland	Rumania	Total	Percentage of Total Produced by the USSR	Percentage of Total Production
Storage batteries b/											
Starting, lighting, and ignition											
Aircraft	12,300			400	1,000			400	14,100	87.2	3.7
Automobile, truck, tractor, and bus	67,900	400	4,100	2,400	5,000	1,600	3,200	800	85,400	79.5	22.2
Motorcycle	2,500			400	300		100	200	3,500	71.4	0.9
Tank	11,800				700				12,500	94.4	3.2
Subtotal	94,500	400	4,100	3,200	7,000	1,600	3,300	1,400	115,500	81.8	30.0
Motive power											
Industrial truck and locomotive propulsion	800				3,000	1,500	400	200	5,900	13.6	1.5
Submarine propulsion	38,500				600		1,000		40,100	96.0	10.5
Torpedo propulsion	25,400								25,400	100.0	6.6
Subtotal	64,700				3,600	1,500	1,400	200	71,400	90.6	18.6
Stationary	8,200			100	3,000		50	300	11,700	70.1	3.0
Railroad diesel starting	700								700	100.0	0.2
Railroad car air conditioning and lighting	N.A. c/			100	2,500			200	2,800	N.A. c/	0.7

* Footnotes for Table 7 follow on p. 35.

Table 7

Estimated Value of Production of Electric Batteries in the Sino-Soviet Bloc, by Type a/
1956
(Continued)

Type of Battery	Value (Thousand 1955 US $) USSR	Bulgaria	Communist China	Czecho-slovakia	East Germany	Hungary	Poland	Rumania	Total	Percentage of Total Produced by the USSR	Percentage of Total Production
Storage batteries b/ (continued)											
Alkaline storage batteries											
Nickel-cadmium, all types	38,800				6,500		200		45,500	85.3	11.8
Nickel-iron, all types	34,200			500					34,700	98.6	9.0
Subtotal	73,000			500	6,500		200		80,200	91.0	20.8
Total	241,100	400	4,100	3,900	22,600	3,100	5,000	2,100	282,300	85.4	73.3
Primary batteries											
Flashlight	40,000	100	4,000	800	1,500	600	1,100	500	48,600	82.3	12.6
Radio	26,900	100	2,400	3,700	2,800	600	3,000		39,500	68.1	10.3
Other d/	12,100		1,000	700	500	100	100		14,500	83.4	3.8
Total	79,000	200	7,400	5,200	4,800	1,300	4,200	500	102,600	76.9	26.7
Grand total	320,100	600	11,500	9,100	27,400	4,400	9,200	2,600	384,900	83.2	100.0

a. Because of rounding, figures may not add to the totals shown.
b. All storage batteries are of the lead-acid type unless otherwise indicated.
c. Production is known to exist, but estimates of quantity cannot be distinguished from those for similar product types shown in this table.
d. Primarily composed of general-purpose dry cells.

Table 8

Estimated Distribution of Electric Batteries
in the Sino-Soviet Bloc, as Percentages of Each Type of Battery
1956

Percent a/

Type of Battery	Industry b/	Civilian Consumption	Power Networks	Communications Networks	Direct Military End Items
Storage batteries c/					
Starting, lighting, and ignition					
Aircraft					100
Automobile, truck, tractor, and bus	50	10			40
Motorcycle		50			50
Tank					100
Motive power					
Industrial truck and locomotive propulsion	100				
Submarine propulsion					100
Torpedo propulsion					100
Stationary			50	50	
Railroad diesel starting	100				
Railroad car air conditioning and lighting	100				
Alkaline storage batteries					
Nickel-cadmium, all types	10			60	30
Nickel-iron, all types	60		10	10	20
Primary batteries					
Flashlight	10	80			10
Radio		80			20
Other d/	40	20			40

a. Each type of battery totals 100 percent.
b. Not including batteries for end items manufactured by industry for consumption in other sectors.
c. All storage batteries are of the lead-acid type unless otherwise indicated.
d. Primarily composed of general-purpose dry cells.

Table 9

Estimated Distribution of Electric Batteries
in the Sino-Soviet Bloc, as Percentages of Total Production
1956

Percent

Type of Battery	Industry a/	Civilian Consumption	Power Networks	Communications Networks	Direct Military End Items	Total
Storage batteries b/						
Starting, lighting, and ignition						
Aircraft					3.7	3.7
Automobile, truck, tractor, and bus	11.1	2.2			8.9	22.2
Motorcycle		0.4			0.5	0.9
Tank					3.2	3.2
Motive power						
Industrial truck and locomotive propulsion	1.5					1.5
Submarine propulsion					10.5	10.5
Torpedo propulsion					6.6	6.6
Stationary			1.5	1.5		3.0
Railroad diesel starting	0.2					0.2
Railroad car air conditioning and lighting	0.7					0.7
Alkaline storage batteries						
Nickel-cadmium, all types	1.2			7.1	3.5	11.8
Nickel-iron, all types	5.4		0.9	0.9	1.8	9.0
Primary batteries						
Flashlight	1.3	10.0			1.3	12.6
Radio		8.2			2.1	10.3
Other c/	1.5	0.8			1.5	3.8
Total	22.9	21.6	2.4	9.5	43.6	100.0

a. Not including batteries for end items manufactured by industry for consumption in other sectors.
b. All storage batteries are of the lead-acid type unless otherwise indicated.
c. Primarily composed of general-purpose dry cells.

Table 10

Estimated Labor Force of the Electric Battery Industry in the Sino-Soviet Bloc
1957

Country	Number	Percentage of Total
USSR	30,000	60.3
Bulgaria	400	0.8
Communist China	6,000	12.1
Czechoslovakia	2,000	4.0
East Germany	5,700	11.4
Hungary	1,000 to 1,500 a/	2.0 to 3.0 a/
Poland	3,500	7.0
Rumania	1,200	2.4
Total	49,800 to 50,300 a/	100.0 a/

a. Uncertain because of the Hungarian rebellion of October 1956.

Table 11

Estimated Inputs of Selected Materials for Production of Electric Batteries in the Sino-Soviet Bloc 1956

Thousand Metric Tons

Type of Battery	Antimonial Lead	Nickel	Cadmium	Iron	Steel Container	Nonmetallic Battery Cases	Separators and Sealing Compound	Manganese Dioxide	Zinc	Carbon	Paper	Electrolyte
Storage batteries a/												
Starting, lighting, and ignition												
Aircraft	9.4					3.2	2.7					4.1
Automobile, truck, tractor, and bus	77.2					30.0	25.7					38.6
Motorcycle	2.5					1.0	0.8					1.2
Tank	11.8					4.0	3.4					5.1
Motive power												
Industrial truck and locomotive propulsion	4.3					1.4	1.2					1.7
Submarine propulsion	20.9					4.0	3.5					5.2
Torpedo propulsion	6.9					1.3	1.1					1.7
Stationary	10.6					3.9	3.4					5.1
Railroad diesel starting	0.5					0.2	0.1					0.2
Railroad car air conditioning and lighting	1.2					0.4	0.3					0.5
Alkaline storage batteries												
Nickel-cadmium, all types		2.1	0.7		3.4		3.4					2.2
Nickel-iron, all types		4.1		1.4	6.4		6.4					4.0
Primary batteries												
Flashlight							10.2	16.9	14.2	5.5	0.5	13.5
Radio							3.6	8.2	8.9	2.6	3.3	6.1
Other							4.6	7.6	6.4	2.5	0.2	6.1
Total	145.3 b/	6.2	0.7	1.4	9.8	49.4	70.4	32.7	29.5	10.6	4.0	95.3

a. All storage batteries are of the lead-acid type unless otherwise indicated.
b. Antimonial content is about 6 percent: that is, approximately 8,700 metric tons of antimony.

APPENDIX B

MANUFACTURING FACILITIES

This appendix gives basic information on each of the major battery plants in the Sino-Soviet Bloc. The basic information includes the name of the plant, its location, its products, the estimated labor force, and comments pertaining to its history and technology. Plants are listed according to country, in alphabetical order by city.

[p 40 blank]

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
USSR					
Alma-Ata	Alma-Ata Storage Battery Plant 39/ Russian name: Alma-Atinskiy Akkumulyatornyy Zavod Address: 57 Pastera Ulitsa	Storage (lead-acid)	Automobile	100	This plant probably was established after World War II, about 1945 or 1946. Some of the plant machinery was rebuilt in 1947, and a grid-casting foundry was put in operation. Previously the plant had received grids from Yaroslavl'. The plant consistently has fulfilled its production plan and has reduced costs appreciably. In 1956, batteries were being repaired as well as manufactured. The plant was subordinate to the Ministry of Motor Transport of Kazakhskaya SSR and is the only enterprise in that republic producing storage batteries.
Ashkhabad	Ashkhabad Storage Battery Workshops 40/ Russian name: Ashkhabadskiy Akkumulyatornyy Masterskiye	Storage (lead-acid)	Automobile Truck	100	This plant probably was established about 1950. It repairs and builds batteries. It consistently has exceeded its plans and was modernized in 1955. The Soviet press has made much of the plant's innovation of substituting iron for lead for intercell connectors. The plant is the only storage battery plant in Turkmenskaya SSR and is subordinate to the Ministry of Motor Transport of Turkmenskaya SSR.
Baku	Submarine Battery Plant 41/ Address: 30-32 Krasnopresnenskaya Ulitsa	Storage (lead-acid)	Submarine	N.A.	Plant equipment probably was brought from a dismantled battery plant in Asbest in 1946. No positive evidence exists that the plant produces submarine batteries, but its location and the submarine activity in the Caspian Sea suggest that such production is probable.
Gomel'	Battery Plant 42/ Address: approximately 1 kilometer (km) north of the center of the city.	Primary Storage (lead-acid)	Flashlight Submarine	1,200	Badly damaged during World War II, this plant was rebuilt with modern equipment and resumed production in March 1947. A fairly large research laboratory is located in the plant.
Ivanovo	Galvanic Battery Plant 43/ Russian name: Zavod Gal'vanicheskikh Batariy	Primary	Flashlight Radio Spare elements	400	This plant is a new plant reported to be under construction in 1954. It is estimated that the plant was brought into operation in 1955.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
USSR (Continued)					
Klaypeda	Sirius Electric Battery Cell Plant 44/	Primary	Flashlight	N.A.	This Lithuanian plant expanded rapidly immediately after World War II, but it was criticized for producing flashlight cells of poor quality. The plant mechanized its operations in 1954 and 1955 for the mass production of flashlight cells for the SKE-P-32 pocket flashlight.
Komsomol'sk	Komsomol'sk-on-Amur Storage Battery Plant, Plant No. 364 45/ Russian name: Komsomol'sk-na-Amure Akkumulyatornyy Zavod Address: located on Pionerskaya Ulitsa (about 5 km east-southeast of the railroad station)	Storage (lead-acid)	Automobile Diesel starting Submarine Tank	1,000	This plant was probably a small storage battery repair shop when it was established before World War II. It was expanded during the war, and a major expansion project carried out after the war was completed in early 1948. This plant is a major producer of submarine batteries. Most of its submarine batteries are shipped to shipyards on the Amur River. Other batteries are shipped all over the USSR, reportedly as far west as Minsk.
Komsomol'sk	Storage Battery Plant 46/ Russian name: Akkumulyatornyy Zavod Address: approximately 4 km northeast of the railroad station in Komsomol'sk	Storage (lead-acid)	Aircraft Automobile	700	This plant probably was established during World War II to supply aircraft batteries, when the Germans overran the western USSR, and may be administratively part of Plant No. 364 in Komosomol'sk. The plant may have been expanded in 1947.
Kursk	Storage Battery Plant, Plant No. 111 47/ Russian name: Akkumulyatornyy Zavod Address: northwest outskirts of the Ryshkovo suburb of Kursk	Storage (lead-acid and alkaline)	Automobile Diesel starting Motive power Stationary Submarine Torpedo	1,000	Construction of this plant was initiated immediately before World War II, suspended during the war, and resumed in 1945. Equipment was obtained from the submarine and torpedo battery plant built by the Germans in Posen, Poland, in 1943. The Posen plant was a modern, high-capacity plant. The repair and charging of storage batteries began in 1946, but batteries probably were not produced until 1949 or 1950. Only lead-acid storage batteries were produced up to 1954, when the production of alkaline batteries was organized.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
USSR (Continued)					
Leningrad	Lenin's Spark Storage Battery Plant, Plant No. 584 48/ Russian name: Leninskaya Iskra Akkumulyatornyy Zavod Address: Profesora Popova Ulitsa 38	Storage (lead-acid and nickel-iron)	Aircraft Automobile Diesel starting Motive power Stationary Submarine	2,500	This plant is the oldest battery plant in the USSR and was established by the Tudor firm in 1897. Before World War II it was the largest battery plant in the USSR and boasted on excellent research and development laboratory called the Central Accumulator Laboratory (now called the Scientific Research Institute for Storage Batteries), the only one of its kind in the USSR. The plant was neither evacuated nor severely damaged during the war. It was in full operation in 1946 and instituted a modernization program in 1948. Through this program the plant plans to double its 1955 production by 1960. The plant is presently the second or third largest battery plant in the USSR.
Leningrad	Storage Battery Plant imeni Lieutenant Shmidt, Plant No. 223 49/ Russian name: Akkumulyatornyy Zavod imeni Leytenanta Shmidta Address: Ulitsa Kalinina 50a	Storage (lead-acid)	Automobile Motorcycle Submarine Tank	1,500	This plant was established in 1912 by the German branch of the English Tudor Co. During World War II it was destroyed 70 percent but was rebuilt by prisoner-of-war labor after the war. It was a very large plant before the war and is now a prime producer of submarine batteries.
Leningrad	Scientific Research Institute for Storage Batteries 50/ Russian name: Nauchno-Issledovatel'skiy Akkumulyatornyy Institut Address: next door to the Iskra plant, Plant No. 584	Research	None	600	This institute formerly was the Central Accumulator Laboratory. Before World War II the laboratory was concerned principally with submarine and alkaline batteries and with copying German machinery for the production of lead powder. Since the war the institute has been criticized for allowing the technology of storage battery manufacture to be very backward. The chief criticism is that the institute has been so preoccupied with problems concerned with current production that many manufacturing plants have not had help in mastering new types of production.
Leninsk-Kuznetskiy	Leninsk-Kuznetskiy West Siberian Battery Plant 51/ Russian name: Leninsk-Kuznetskiy Zavod "Zapsibelement" Address: approximately 500 meters northeast of the railroad station	Primary Storage (alkaline)	Flashlight General purpose Radio Batteries for miners' lamps	600	This plant was established in November 1941 from equipment evacuated from the Moselement plant (No. 220) in Moscow and was located in what had been a small repair shop for batteries. Some automobile batteries may have been produced immediately following World War II. The main product now is the alkaline battery for the Kuzbas miners' lamps.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
USSR (Continued)					
Makar'yevo	Battery Plant, Plant No. 389 52/ Russian name: Batareynyy Zavod Address: approximately 3 km southeast of the railroad station in Makar'yevo on the west side of the Angara River	Primary Storage (lead-acid)	Flashlight General purpose Radio Automobile Submarine Tank	3,000	This plant probably was established in the early 1920's and was expanded in 1941 by the addition of equipment evacuated from Leningrad. Submarine batteries allegedly are supplied by the plant to Vladivostok for the Soviet Pacific fleet. Other types of batteries are shipped all over the USSR, reportedly as far west as Minsk. The plant is actually 2 plants at 1 location, because production of lead-acid storage batteries and that of primary batteries have no technical processes in common. The plant equipment is primarily of US origin with the remainder from Germany and England. This equipment requires much hand operation, particularly in the handling of materials between processes. It is estimated that this plant, 113 km northwest of Irkutsk, is the fourth largest battery plant in the USSR.
Moscow	Moscow Electric Cell Plant, Plant No. 220 53/ Russian name: Moskovskiy Elementnyy Zavod or Moselement Address: Novoalekseyevskaya Ulitsa 46a	Primary	Flashlight General purpose Radio Special cells for radiosondes	3,000	This plant was established in 1929, evacuated to Leninsk-Kuznetskiy in November 1941, and partially re-evacuated from Leninsk-Kuznetskiy to Novosibirsk in December 1941. The extent of the evacuated equipment later returned to Moscow is not known, but it is estimated that the plant has been restored and augmented since World War II. In 1941 the plant produced about 80 percent of the primary batteries manufactured in the USSR. At present it is still the largest producer of primary batteries in the USSR by a wide margin. The zinc-soldering department was automated in 1953, thus considerably improving the productivity of the plant.
Novorossiysk	Battery Plant 54/ Address: about 2 or 3 km south of the city center	Primary Storage (lead-acid)	Radio Aircraft Automobile Submarine	700	This plant was very small before World War II and probably did not produce submarine batteries, although it might have repaired them. Immediately following the war it was reported that this then fairly large plant was specializing in the production of submarine batteries.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
USSR (Continued)					
Novosibirsk	Electrosignal Radio Plant, Plant No. 590 55/ Russian name: Elektrosignal Radic Zavod Address: Bol'shevistskaya Ulitsa	Primary Storage (lead-acid)	Radio Stationary	1,100	This plant was established in 1941 from equipment evacuated from a radio plant in Voronezh. It produces radio products, particularly military communications equipment. Batteries, however, appear to be the major part of production. The plant may have been subordinate to the Ministry of the Defense Industry.
Podol'sk	Podol'sk Storage Battery Plant, Plant No. 710 56/ Russian name: Podol'skiy Akkumulyatornyy Zavod Address: Serpukhovskaya Ulitsa 20	Storage (lead-acid)	Automobile	1,000	Construction of this plant commenced in 1933, and the plant was put into operation in 1935. The plant was evacuated during World War II and returned to Podol'sk in 1945. After the war it was restored with new US and dismantled German equipment. The plant was probably not expanded to its prewar size until after 1950. Its products are not good, the average life of its batteries being 3 to 6 months according to tests run on the automobile parks of Moscow organizations from 1940 to 1949. The plant's products are apparently used chiefly to equip new vehicles produced at plants in Gor'kiy, Moscow, and Yaroslavl'. This plant is the largest producer of automotive types of batteries in the Sino-Soviet Bloc.
Pskov	Storage Battery Plant 57/ Russian name: Akkumulyatornyy Zavod	Storage (lead-acid)	Aircraft Automobile Motorcycle Submarine	700	This plant was constructed during 1945 and 1946 and has been producing since 1946. It probably is equipped with expropriated German equipment.
Riga	Riga Storage Battery Plant 58/ Russian name: Rizhskiy Akkumulyatornyy Zavod Address: Ulitsa Lenina 115	Storage (lead-acid)	Automobile	400	This plant was established before World War II and was damaged slightly during the war. Hand operations are used extensively.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
USSR (Continued)					
Saratov	Storage Battery Plant, Plant No. 236 59/ Russian name: Akkumulyatornyy Zavod Address: approximately 800 yards south-southwest of the main passenger station in Saratov	Storage (lead-acid)	Aircraft Automobile Motorcycle Shipboard Stationary Submarine Tank Torpedo	2,000	This plant probably was built in the early or middle 1930's and was not damaged during World War II. New machinery was received from Germany and installed in 1946. Electric carts are used for intraplant transport of heavy raw materials and semimanufactures. Battery cases are received from the rubber plant (Plant No. 702) in Saratov. Much of the finished product goes to the automobile works in Gor'kiy and Moscow and the jet aircraft plant (Plant No. 1) in Kuybyshev. The largest customer is probably the Soviet Navy, which receives ship, torpedo, and submarine batteries from this plant. The plant has been criticized for producing short-lived automobile batteries and is alleged to have an exceedingly high reject rate.
Saratov	Storage Battery Plant, Plant No. 195 60/ Russian name: Akkumulyatornyy Zavod Address: approximately 2.5 miles southwest of the main passenger station in Saratov on the south side of Astrakhanskaya Ulitsa	Storage (alkaline)	Aircraft Batteries for miners' lamps Motive power Stationary	3,000	This plant is the largest battery producer in the USSR. It probably was built shortly before World War II. The Swedes, probably the Swedish NIFE Company, helped build the plant and supplied design and production technology. The plant was not damaged during the war, but some machinery was removed as a precautionary measure. This machinery was replaced and augmented immediately after the close of hostilities. Producing only alkaline batteries, the plant is modern, clean, and well equipped with materials handling equipment and good German machinery of prewar and postwar vintage. This plant produces a good product by Soviet standards although of somewhat inferior design compared to similar US and Western European models.
Tallinn	Tallinn IKA Battery Plant 61/ Address: Kalininskaya Ulitsa 40	Primary	Flashlight General purpose Radio	100	This small plant was established before World War II and is subordinate to the Ministry of the Local and Shale-Chemical Industry of the Estonian SSR. It was fulfilling its plan fairly well through 1953 but substantially underfulfilled the plan in 1954 because of a shortage of zinc and carbon. The priority of the plant is probably low, because only batteries for civilian use are produced.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
USSR (Continued)					
Tashkent	Tashkent Storage Battery Plant 62/ Russian name: Tashkentskiy Akkumulyatornyy Zavod Address: west-northwest of the railroad station in Tashkent	Storage (lead-acid)	Automobile Tank	1,000	This plant probably was built during or immediately following World War II. The plant is well organized and technologically progressive. Lead mining and smelting facilities are in close proximity.
Tyumen'	Tyumen' Storage Battery Plant 63/ Russian name: Tyumenskiy Akkumulyatornyy Zavod Address: approximately 700 meters southwest of the Tura bridge on Lunasaskaya Ulitsa	Storage (lead-acid)	Automobile	200	This plant allegedly was established from equipment evacuated from Moscow in 1941. It receives battery cases from Sverdlovsk and ships finished batteries to Gor'kiy and Moscow. New equipment, which was installed in 1953, significantly increased production capacity. The annual plan was fulfilled in 1954.
Vladivostok	Storage Battery Plant 64/ Russian name: Akkumulyatornyy Zavod Address: approximately 4 km southeast of the railroad station in Vladivostok	Storage (lead-acid)	Submarine	N.A.	This plant probably was established during World War II to service the Soviet Pacific fleet with submarine batteries. It may be only a battery repair facility.
Voroshilovgrad	Voroshilovgrad Storage Battery Plant 65/ Russian name: Voroshilovgradskiy Akkumulyatornyy Zavod (VAZ)	Storage (N.A.)	N.A.	N.A.	This plant simply was mentioned as being a storage battery plant subordinate to Glavakkumulyatorprom of the Ministry of the Electrotechnical Industry.
Yelets	Carbon Electrode Plant, Plant No. 351 66/ Russian name: Yeletskiy Zavod Prozhektornyy Ugol' Address: on the southern outskirts of Yelets on the western side of the Sosna River	Primary.	Flashlight General purpose Radio	1,000	This plant was established about 1935. Expansion was under way in 1939, interrupted by World War II, and resumed in 1945. The plant suffered severe damage during the war. Equipment from the Pertrix plant in Berlin and modern US equipment was installed during the period 1945-48. Some construction was still under way in 1949. Since the latter part of 1951 the plant apparently has fulfilled or overfulfilled plans consistently.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
Bulgaria					
Sofia	"Rayko Damyanov" Accumulator-Battery Plant 67/	Primary Storage (lead-acid)	Flashlight Radio Automobile General purpose	100	This plant was organized in 1948 for production of storage batteries. Production of primary batteries probably was added in 1954.
Sofia	Plant No. 12 68/ Address: Totleben Ulitsa near Aleksandrova Hospital	Primary Storage (lead-acid)	Flashlight Radio Automobile	300	This plant is the former engineering plant which was redesignated Plant No. 12 in 1950. The plant was very small in 1945, when it was created by merging several small private firms. Products of the plant include vehicle chassis and body and agricultural machinery and flashlights, as well as batteries. Irregular deliveries of raw materials and low worker morale resulting from poor working conditions have served to inhibit production. The plant has expanded somewhat since World War II, however, and new building and machinery were added in 1955. Much of the new machinery was imported from Czechoslovakia and East Germany, although the old equipment is almost all German.
Communist China					
Canton	Chien-hang Storage Battery Plant 69/ Address: No. 1-1, Hua-yuan-kung-lu, Pei-chiao	Storage (lead-acid)	Automobile Stationary	700	This plant is a local government-operated battery plant. It uses the aircraft trademark.
Canton	Hsing-hua Battery Plant 70/ Address: Chin-sha Road, Ho-nan	Primary	Flashlight	400	Established in 1929, this joint state and privately operated plant is alleged to be the largest plant of its kind in Communist China. It produces the Wu-yang brand primary cell with a trademark consisting of five sheep or goats. The plant was expanded about 50 percent in the summer of 1953, and further expansion up to 4 times its size in 1952 was contemplated.
Canton	New Southwest Dry Cell Plant 71/ Address: 22 T'ung-Ch'ing Fang, Yung-han Nan Lee	Primary	Flashlight	N.A.	This plant is known to have been in existence at least since 1954 because a dry cell acquired from the plant was found to have been produced in 1954. The flashlight cell had an airplane trademark and looked like a "Ray-O-Vac" (brand of US manufacturer of flashlight cells) flashlight cell. Hand operations are used extensively at this plant.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
Communist China (Continued)					
Canton	Yung Yao Battery Plant 72/	Primary	Flashlight	100	This plant was established in 1937 and is probably a privately owned plant. Its trademark is a flying elephant.
Hankow	Hankow Battery Plant 73/ Address: No. 1259, Chung-shan-ta-tao	Storage (lead-acid)	Automobile	200	This plant probably was established before World War II. The National Resources Commission of Nationalist China planned to expand the plant when operating it in 1948. The Communist regime took the plant over in October 1949 and claimed to have increased production fourfold by March 1950, while depending upon domestic supplies of manganese dioxide rather than importing. The plant uses the Sun-Moon brand.
Harbin	Harbin Battery Plant 74/	Primary Storage (lead-acid)	Flashlight General purpose Radio Aircraft Automobile Tank	150	This plant probably was established shortly after the close of World War II. Initially only primary batteries were produced, but by 1949 or 1950 the production of storage batteries had been organized. Apparently ebonite (hard rubber) containers for storage batteries are manufactured by the plant for its own use. A nonbattery product, graphite brushes for electric motors, also is produced here.
Lung-chiang	Dry Cell Battery Plant 75/	Primary	General purpose Radio	140	This plant probably is government operated. Batteries are of poor quality.
Mukden	Mukden Battery Plant 76/	Primary Storage (lead-acid)	Flashlight Radio Aircraft Automobile Tank	800	Founded on 29 December 1937 by the Japanese as the Manchurian Dry Cell Manufacturing Co., the plant survived World War II as a small producer of dry cells. Gradually expanded after the war, the plant began to produce storage batteries in addition to dry cells by about 1950. Automotive types of batteries in sizes for everything from tractors to tanks are manufactured, using Soviet standards and specifications.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
Communist China (Continued)					
Shanghai	Po-shan Battery Plant 77/ Address: No. 120 Fu-chou Lu	Primary	Flashlight Radio Other	1,000	This state-operated plant is the major Chinese producer of storage batteries other than the automotive type. It probably was established in the early 1930's.
		Storage (lead-acid)	Automobile Diesel starting Motive power Railroad lighting Stationary		
Shanghai	Remy Storage Battery Manufacturing Co. 78/	Storage (lead-acid)	Automobile Other	200	This firm in 1951 was a private enterprise which sold batteries to both public and private consumers. It probably is state owned at present. The firm is also known by the name of Lien-mei Battery Manufacturing Co.
Shanghai	Shanghai Dry Battery Plant 79/	Primary	Flashlight Radio Other	800	This plant probably is the largest producer of primary batteries in Communist China and produces the lighthouse brand. Considerable improvement in prolonging the operating life of its products was claimed in 1955. The reject rate in 1954 was very low, about 0.5 percent.
Wu-han	Wu-han Battery Plant 80/ Address: No. 2, Ch'ang-sha Hou-hsiang, Min-ch'uan Lu	Primary	N.A.	N.A.	This joint state-private plant was formed in January 1956 by merging 14 small plants. Manual methods have been replaced largely by machine methods. For example, such operations as mixing, sifting, and buffing have been mechanized.
Czechoslovakia					
Budisov nad Budisovkou	Bateria Dry Cell Plant 81/	Primary	Flashlight	150	None.
Ceska Lipa	Ceska Lipa Storage Battery Plant 82/	Storage (lead-acid)	Motive power Plates for use in repairing batteries Tank	100	This plant was established in 1944 as a branch of the Sonnenschein Plant in Berlin. It is the only plant in Czechoslovakia which produces batteries for the new traction equipment, heavy artillery, and tanks produced at the Skoda Works. The productivity of this plant appears to be much higher than that of other Czechoslovak plants.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
Czechoslovakia (Continued)					
Mlada Boleslav	Prazska Storage Battery Plant 83/	Storage (lead-acid and alkaline)	Aircraft Automobile Motive power Motorcycle Plates for use in repairing batteries Stationary	300	Established before World War II, this plant is the main plant of the Prazska Akumulatorka National Corporation, which controls storage battery production in Czechoslovakia, and is the headquarters for the administrative apparatus of the corporation. The plant is the largest storage battery plant in Czechoslovakia, being the predominant producer of lead-acid storage batteries and producing 20 percent of the country's requirements for alkaline storage batteries.
Prague	Prague Storage Battery Plant 84/ Address: Administrative Office: 10 Spanelska St. Zetkovi Plant Address: Zizkova Ulice 32, Prague-Karlin Letna Plant Address: Prague-Letna Nife Plant Address: Hostivarska Siln 1780 Svobodove Plant Address: Borivojova 17	Storage (lead-acid and alkaline)	Automobile Other	200	This firm is made up of four small manufacturing plants in separate locations. The administrative office is at the same address as the Bateria National Corporation (which controls the production of primary batteries), although the plant is subordinate to the Prazska Akumulatorka National Corporation in Mlada Boleslav. The component plants, which had been founded before World War II, all were privately owned until 1950. The most important of the component plants was the former Nife Stahlakkumulatoren AG, which was built by a German firm and is estimated to supply about 60 percent of the nickel-steel alkaline storage batteries required by Czechoslovakia.
Radotin	Asta Storage Battery Plant 85/	Storage (lead-acid and alkaline)	Automobile Motive power Railroad lighting Stationary	100	This plant was founded before World War II and supplies about 20 percent of the country's requirements of nickel-steel batteries.
Slany	Peoples Plant "Bateria" 86/ Address: Netovicka 875	Primary	Flashlight Other Radio	1,000	Surviving World War II undamaged, this plant, the largest in Czechoslovakia, was expanded after 1949 from its prewar size, although in 1945 its production facilities for storage batteries were removed to other plants. Apparently the Bateria plants began preparing to specialize in the production of primary batteries immediately following the war.
Usti nad Labem	Elka Storage Battery Plant 87/ Address: Perstynska Ulice 6	Storage (lead-acid)	Automobile	100	This plant was built before World War II and was known as Langstein and Klein up to 1945.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
East Germany					
Berlin	Peoples-Owned Storage Battery Plant in Oberschoeneweide 88/ German name: VEB Akkumulatorenfabrik Oberschoeneweide Address: Wilhelminenhof Strasse 68/69, Berlin-Oberschoeneweide	Storage (lead-acid)	Aircraft Automobile Stationary Submarine Tank	1,100	Formerly the Storage Battery Plant "Varta," this plant was established in 1900 and was damaged slightly during World War II. After the war the USSR removed 90 percent of the plant's equipment and took over the operation of the remaining facilities. The plant was returned to the control of East Germany on 29 April 1952. Lead was imported from the USSR during 1951 and 1952 to meet a severe lead shortage. Most of the end products have been exported to the USSR. The plant has a good laboratory and fully automatic grid-casting equipment. Because of poor working conditions, however, a large proportion of the labor force is composed of convicts.
Berlin	Peoples-Owned Berlin Battery and Cell Plant 89/ German name: VEB Berliner Batterie- und Elementefabrik Address: Bruno-Buergel-Weg, 69-81, Berlin-Niederschoeneweide	Primary	Flashlight Radio Other	500	This plant was established before World War II and was not damaged during the war. Because some production of unspecified batteries with high rates of discharge exists, the plant may supply batteries for guided missiles and/or other military applications.
Berlin	Pertrix Dry Battery Works 90/ Address: 53a Sedanstrasse, Berlin-Niederschoeneweide	Primary	Flashlight Radio Other	500	During World War II this plant produced batteries for guided missiles and may still do so. The plant was dismantled in 1945 and partially restored in 1946. The dismantled equipment was appropriated by the USSR for Plant No. 351 in Yelets. The plant has a research laboratory which was completely staffed by Russians after the war until about 1952. The plant has not been able to produce at full capacity because of chronic shortages of raw materials, particularly zinc, ammonium chloride, manganese dioxide, and magnesium chloride.
Dresden	Dresden Storage Battery Plant 91/ Address: Donaerstrasse 6-8	Storage (lead-acid)	Automobile Motorcycle Tank	100	Tank batteries have been exported to the USSR. Lead is obtained domestically, but rubber battery cases are imported from Sweden and Czechoslovakia. Material shortages forced a reduction in the labor force in 1951.
Groeningen	Peoples-Owned Storage Battery Plant in Groeningen 92/ German name: VEB Akkumulatorenbau Groeningen	Storage (lead-acid)	Automobile Motorcycle	50	This plant was constructed during 1949 and 1950 and put into operation in 1950. It was enlarged somewhat in 1954.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
East Germany (Continued)					
Grossstadtein (near Leipzig)	Venta Battery Plant 93/	Primary Storage (lead-acid)	Radio Automobile Motorcycle	500	This plant probably was established before World War II. A lead shortage forced the plant to shut down temporarily in 1949.
Sonneberg	Rulag Werke Battery Plant 94/	Primary Storage (lead-acid)	Flashlight Automobile Tank	500	Probably established before World War II, this plant is alleged to produce flashlight cells of "unusual storage capacity" (long shelf life or high output per unit of weight?) and are used to provide power for electrical instruments in submarines. Most of the plant's production has gone to the USSR.
Tabarz	Falk Battery Plant 95/	Primary	Flashlight General purpose Radio	150	Women compose the majority of the labor force of this plant, and plant operations are performed by hand. Production of the plant is consumed domestically. The brand name used by the plant is "Mono."
Worbis	Peoples-Owned Battery Plant in Worbis 96/ German name: VEB Batteriefabrik Worbis Address: Querstrasse 16	Primary	Radio Other	250	This plant produces chiefly for the East German and Soviet armies. It has a research and development laboratory, but the laboratory personnel are not regarded highly. The plant has suffered periodic shortages of carbon, graphite, and zinc, particularly in 1953 and 1955.
Zeitz	Zeitz Dry Battery Plant 97/ German name: Trockenelementefabrik Zeitz Address: Liebknechtstrasse about 0.5 km from the railroad station in the direction of Altenburg	Primary	Flashlight Radio	700	This plant produces radio batteries for the Volkspolizei (Peoples Police) and the army and flashlight cells for civilian consumption. The plant has been hampered periodically by shortages of zinc and manganese dioxide. It was formerly the Ehlers Battery Plant.
Zwickau	Peoples-Owned Mining Lamps Plant in Zwickau 98/ German name: VEB Grubenlampenwerke Zwickau Address: Works I: Reichenbacher Strasse 64-68; Works II: About 1 km west of Plant I; Works III: Schwanenteich Strasse	Storage (lead-acid and alkaline)	Automobile Batteries for miners' lamps (nickel-cadmium, alkaline type) Motive power Motorcycle	1,300	Established by the German firm of Friemann and Wolf, this plant suffered no damage during World War II. There are three works composing the plant, alkaline batteries being produced in Works I and lead-acid batteries in Works II. Works III is a mechanical workshop. The plant was taken over by the USSR after the war and returned to East Germany in 1952. Hand operations are employed predominantly. Only the grid-pasting operation is mechanized, and the equipment employed here is modern and in good condition. Most of the end products are exported to countries of the Sino-Soviet Bloc.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
Hungary					
Budapest	Storage Battery and Dry Cell Plant 99/ Hungarian name: Akkumulator es Szarzelem Gyar Address: Vaci-ut 137/139, Budapest XIII	Primary Storage (lead-acid and alkaline)	Flashlight Radio Other Aircraft Alkaline, several types Automobile Marine Motorcycle Stationary	1,200	This plant is the oldest and largest battery plant in Hungary, having been established in 1890 by AFA (Akkumulatoren-Fabrik AG of Berlin), which owned the plant until 1945. After World War II it was taken over by the USSR as former German property. No damage was suffered by the plant during the war. The plant was returned to Hungary in 1952. Since 1951 the plant has been modernized and enlarged by the process of absorbing the facilities of other Hungarian plants. For example, the Polus Sirius Battery Plant was absorbed in 1951. Other plants, now defunct, which were absorbed were the Nife Storage Battery Plant and Electrical Engineering Joint Stock Co., Pertrix Battery Plant, and the Hoppecke Storage Battery Plant. The existing equipment is primarily of German and Hungarian prewar makes. New techniques of production are being adopted in order to increase output. Experimentation is conducted in the field of alkaline batteries for diesel starting. The problem of replacing imported materials -- lead, rubber, and wood, primarily -- by materials domestically produced also is under continuous study. A high percentage of production has been exported to the USSR since the war.
Budapest	Electrical Equipment and Storage Battery Plant 100/	Storage (lead-acid)	Automobile	300	This plant is the former Varta Storage Battery Plant, which was expanded and renamed in 1950. Now various electrical switches and transformers as well as batteries are produced in this plant. About 30 percent of the original prewar plant was destroyed during World War II but had been restored by 1950. The plant has old equipment, lacks materials, and produces a product of poor quality. About 75 percent of its production has been exported to the USSR since the war.
Poland					
Bielsko	Petrea Polish Storage Battery Plant 101/ Address: Leszczynaka 5 (in the Biala suburb of Bielsko)	Storage (lead-acid and alkaline)	Automobile Batteries for miners' lamps (nickel-iron alkaline type) Motive power Stationary	300	This plant was established in 1922, survived World War II with negligible damage, and was slightly expanded in 1950. The plant fulfilled the annual plan for 1955.
Gdansk-Orunia	Daimon Cell and Battery Plant 102/ Address: Sandomierska 11	Primary	Flashlight Lantern	N.A.	This plant was founded in 1923 and observed in operation in 1952.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
Poland (Continued)					
Piastow	Piastow Storage Battery Plant, Plant K-8 103/ Address: 20 Ulica Poniatowskiego	Storage (lead-acid)	Automobile Motive power Motorcycle Stationary Submarine	800	Founded in 1924 by the German branch of the Tudor firm, this plant is one of the two large producers of lead-acid batteries in Poland. The plant was not damaged during World War II and probably produced submarine batteries for the German navy. During 1956 the plant was temporarily shut down for remodeling in order to eliminate the dangerous concentration of lead dust in the air. Immediately adjoining this plant is a rubber products plant, which probably supplies battery containers.
Poznan	Electric Cell and Battery Plant 104/ Address: 4 Ulica Grochowe Laki	Primary	Flashlight Radio Other	600	Probably established before World War II, this plant is the largest producer of primary batteries in Poland. The plant produces for export to Turkey, East Germany, Hungary, and other countries as well as for domestic consumption.
Poznan	Centra Element and Battery Plant 105/ Address: Tama Garbarska Street	Primary Storage (lead-acid)	Flashlight Other Automobile Other	1,000	This plant probably is the largest producer of batteries in Poland. It was constructed in the 1930's and partially evacuated to Germany in 1939. After World War II it was re-equipped for the production of both primary and storage batteries and may have been expanded later. Full production was resumed in 1946 for the first time since 1939.
Starograd	Electric Cell and Battery Plant 106/ Address: Kosciuszki 112	Primary	N.A.	N.A.	This plant probably was established before World War II. The quality of its products was reported to be much improved in 1953.
Tczew	"Arkona" Battery Plant 107/ Address: Ulica Mickiwcza 25	Storage	N.A.	400	This plant apparently receives raw materials from the USSR and exports finished products to the USSR. Alkaline batteries may be produced at this plant.
Wroclaw	Blask Battery Plant 108/	Primary	Flashlight Radio Other	400	This plant probably is the second largest producer of primary batteries in Poland.

Country and City	Plant	Production: General Type	Production: End Use	Labor Force (Number)	Comments
Rumania					
Bucharest	Accumulatorul Storage Battery Plant 109/ Address: Grupul 1: Calea Dorobantilor 105; Grupul 2: Calea Rahovei 224	Storage (lead-acid)	Aircraft Automobile Motive power Motorcycle Ship Stationary	800	This plant was formed in 1947 by the merger of several small storage battery plants into two groups (grupul). Grupul 1 was formed from the Tudor Storage Battery Plant and facilities from several unidentified small plants in Bucharest and Timisoara. Grupul 2 was formed by the merger of three plants in Bucharest, formerly called the Rova, Imer, and Akko plants. These plants probably were established before World War II. The facilities of these plants apparently suffered little damage during the war and are still in use today. Because of the obsolete machinery, lack of materials handling devices, and inferior raw materials, the products of the plant are regarded as poor and the productivity of the plant as low. There has been a chronic shortage of raw materials, particularly lead, during the entire period since World War II. Therefore, the plant has never been able to produce at full capacity, and many employees are only partly utilized. The plant apparently has undergone no extensive enlargement or modernization since its formation in 1947.
Timisoara	Electro Banat Plant 110/ Address: Strada A, Pestalozzi 22	Primary	Flashlight Radio	400	This plant is the former Dura Works, which was probably established before World War II. It was renamed about 1951 and expanded considerably. The plant has 3 production sections, 1 of which produces primary batteries. In 1955 the plant fulfilled its annual plan and increased labor productivity about 6 percent more than 1954. Since 1955 the plant has had facilities for refining from domestic ore manganese dioxide, which it formerly imported. Mechanized production processes are employed to a limited extent.

APPENDIX C

METHODOLOGY

I. Production.

A. General Procedure.

Estimates of production of batteries in the Sino-Soviet Bloc initially were made in physical quantities and subsequently were valued in 1955 US prices. Estimates of physical quantity were made for most countries on the basis of plant studies, although for three countries (Bulgaria, Communist China, and Poland) aggregate estimates of an official or semiofficial nature were available for several years of the estimated time series of physical production. Plant studies for the remaining countries resulted in estimates of annual physical production for at least 1 year for each country. The time series were constructed on the basis of estimates of production resulting from plant studies for a given year. With this year as a base year, these estimates were expanded with official indexes of production, if available, and with estimated indexes if official indexes were not available. The estimated indexes are based variously on information relating to technology, new construction, investment in producer goods, extent of damage during World War II, and availability of raw materials.

The time series of production were checked for as many years as was possible with available data on the end-use requirements for batteries. Physical requirement factors for the various consumers of batteries are those estimated to obtain in the Sino-Soviet Bloc. These factors were acquired either directly from sources in the Bloc (mostly open literature) or were estimated by modification of factors obtaining in the US or Western Europe. Factors for every battery use were impossible to acquire; but even if these factors were available, the limited detail of the estimates of production would not admit their application. Available factors, however, permit checks to be made establishing the correct order of magnitude of the estimates of production and concomitantly establishing the probable ranges of error.

B. Plant Studies.

Information on individual manufacturing facilities for batteries in the Sino-Soviet Bloc was examined for references to inputs of specific materials per unit of time and for references to output of specific products per unit of time. From input coefficients based on US practice it was possible to estimate the total volume of annual production for specific installations in specific years. Soviet specifications of particular

[p. 58 blank]

product types were available in sufficient quantity to determine typical product sizes for the various general categories of batteries. These product sizes were used to estimate both total annual output and product mix. Where information on both inputs and outputs existed for the same facility, the information on inputs determined the total volume of production and the information on outputs determined the product mix, although estimates of total output by either inputs or outputs were usually compatible.

In a minority of plant estimates, where input and output information was not available, a factor for labor productivity was applied. The factor used at each plant was based on similar plants in that country if possible or otherwise on similar plants in other countries of the Sino-Soviet Bloc. Factors for labor productivity for the US and for Western European countries were used for comparison. About 10 percent of the total volume of output by the Bloc was estimated in this manner. No estimates of production for major facilities were made by the use of factors of labor productivity. Plant estimates were checked whenever possible, however, by documented figures on labor for indications of the correct size of the labor force. A rather high percentage, about two-thirds, of the plants thus checked produced reasonable figures of labor productivity.

C. Labor Force.

1. USSR.

The labor force in the battery industry of the USSR was estimated for 1950 by plant analysis. Moving the estimate from 1950 to 1957 was accomplished by using the index of labor productivity given by officials of Glavakkumulyatorprom. 111/

2. East Germany and Hungary.

Current information on battery plants in East Germany and Hungary allowed estimates of the labor force to be made directly for 1957.

3. Bulgaria, Communist China, Czechoslovakia, Poland, and Rumania.

Estimates of the labor force in battery plants of Bulgaria, Communist China, Czechoslovakia, Poland, and Rumania were made for various years between 1950 and 1957 by plant analysis. The estimates were moved to 1957 by the index of production for each country.

D. Estimates of Production, by Country.

1. USSR.

Estimates of production were made for the 27 known battery plants of the USSR and are summarized in Table 12.* By combining these estimates, a country estimate of the total output was obtained for the year 1950. The product mix estimated for 1950 was valued by 1955 US dollar prices. The average price per physical unit of output (metric ton) obtained for 1950 was used throughout the time series so that the value and the physical series increase at the same rate over time.**

The actual indexes of production were given by the USSR for the year 1955, with 1950 as the base year for the three categories of batteries: (a) lead-acid storage batteries, (b) alkaline storage batteries, and (c) primary batteries. The planned indexes for 1960 relative to 1955 were given for the same categories of batteries. 112/ The 1950 estimate based on plant production was aggregated accordingly in categories corresponding to those of the Soviet official indexes and expanded over the years from 1950 to 1960 at the average annual rates of increase indicated by the given indexes. From 1960 to 1963 the series were extrapolated at the average annual rate of increase obtaining between 1955 and 1960. From 1950 back to 1946 the series were extrapolated at the average annual rate of increase obtaining between 1950 and 1955. Production for the prewar year, 1938, was estimated on the basis of plant information concerning damage sustained during World War II, new construction during and immediately following World War II, and the transfer of manufacturing facilities from Germany and Poland to the USSR. The three series for the time period 1938 and 1946-63 were added to obtain the time series for the total production of batteries.

Checks were made by end-use requirements for the estimated categories of submarine batteries, tank batteries, automobile and truck batteries, diesel starting batteries, passenger car lighting batteries, flashlight batteries, and radio batteries. The information on end use is based on estimates. 113/ Another check was made on the category of automobile and truck batteries by comparing the ruble value given for automobile batteries in 1955 114/ by the USSR with the estimated output. The ruble price per physical unit was calculated by using the estimate of physical production and was compared to ruble price information published for 1955. The calculated prices fell within the limits set by the prices of typical types and sizes of automotive type storage batteries given in the Soviet price book. 115/

---

* Table 12 follows on p. 62.

** This relationship is only true within each of the three categories -- lead-acid storage batteries, alkaline storage batteries, and primary batteries. The value per metric ton of the total output will change over time.

Table 12

Estimated Volume of Production of Electric Battery Plants
in the USSR
1950

Thousand Metric Tons

Plant Name	Lead-Acid Storage Batteries	Alkaline Storage Batteries	Primary Batteries
Alma-Ata Storage Battery Plant	0.4		
Ashkhabad Storage Battery Workshops	0.2		
Gomel' Battery Plant	0.7		3.1
Ivanovo Galvanic Battery Plant			1.9
Komsomol'sk-on-Amur Storage Battery Plant, Plant No. 364	4.4		
Komsmol'sk Storage Battery Plant	5.6		
Kursk Storage Battery Plant, Plant No. 111	3.2	0.5	
Leningrad Lenin's Spark Storage Battery Plant, Plant No. 584	9.5	1.2	
Leningrad Storage Battery Plant imeni Lieutenant Shmidt, Plant No. 223	8.5		
Leninsk-Kuznetskiy West Siberian Battery Plant		0.3	2.0
Makar'yevo Battery Plant, Plant No. 389	10.1		2.3
Moscow Electric Cell Plant, Plant No. 220			9.0
Novorossiysk Battery Plant	2.1		
Novosibirsk Electrosignal Radio Plant, Plant No. 590	4.2		1.0
Podol'sk Storage Battery Plant, Plant No. 710	7.0		
Pskov Storage Battery Plant	2.7		
Riga Storage Battery Plant	1.4		
Saratov Storage Battery Plant, Plant No. 236	10.2		
Saratov Storage Battery Plant, Plant No. 195		9.0	
Tallinn IKA Battery Plant			1.0
Tashkent Storage Battery Plant	14.0		
Tyumen' Storage Battery Plant	2.8		
Yelets Carbon Electrode Plant, Plant No. 351			5.0
Other plants a/	13.0		0.7
Total	100.0	11.0	26.0

a. Baku Submarine Battery Plant (lead-acid batteries); Klaypeda Sirius Electric Battery Cell Plant (primary batteries); Vladivostok Storage Battery Plant (lead-acid batteries); and Voroshilovgrad Storage Battery Plant (unspecified storage batteries, probably lead-acid).

2. Bulgaria.

Production of storage batteries in Bulgaria was given for 1956 (actual) and 1957 (plan) by the Minister of Heavy Industry. 116/ With these years as bases and with the information that a new plant will probably go into operation at Pazardzhik in 1958, the production series for storage batteries was extrapolated forward to 1963 at an average annual rate of increase of 15 percent and backward to 1946 at an average annual rate of decrease of 12 percent. All storage batteries produced in Bulgaria are estimated to be of the automotive type.

Output of primary batteries in Bulgaria was estimated for 1955 on the basis of plant studies. The time series was extrapolated forward to 1963 at an average annual rate of increase of 12 percent and backward to 1946 at an average annual rate of decrease of 10 percent. All primary batteries produced in Bulgaria are estimated to be flashlight cells. Production of both storage and primary batteries is estimated to have been negligible in the prewar period.

3. Communist China.

Estimates of production of both storage and primary batteries in Communist China were made for 1949 on the basis of plant studies. Estimates of aggregate production for Nationalist China were available for 1946 and 1947 for both primary and storage batteries. 117/ Combining the production of the Mukden Battery Plant with these aggregate estimates produced estimates of total output for 1946 and 1947. The production estimate for the year 1948 was interpolated between the estimates for 1947 and 1949 on the basis of plant information. Based on an index for the production of storage batteries between 1956 and 1957 (plan), 118/ the time series for the storage batteries was extrapolated from 1949 to 1963 at an average annual rate of increase of 18.5 percent, and the time series for primary batteries was extrapolated from 1949 to 1963 at an average annual rate of increase of 20 percent.

Production for the prewar year, 1938, was estimated from aggregate information on Nationalist China 119/ and from plant information concerning the output of the Mukden Storage Battery Plant.

The time series for both storage and primary batteries were checked by end-use requirements using the categories of automotive batteries (storage) and radio batteries (primary). 120/ By assuming relationships between these categories and the total outputs which are similar to those obtaining in the estimated product mix of the USSR, modified for estimated differences, the total output of batteries in Communist China could be roughly checked. Because logical assumptions could be made as to battery life compared with that in the USSR and because it is known that China is a net importer, the estimates of production were determined to be of a reasonable order of magnitude.

4. Czechoslovakia.

Plant studies established the volume of production of batteries in Czechoslovakia for 1950 as well as the product mix. The value of planned production for 1949 was given 121/ and converted to dollars by the koruna-dollar ratio established by plant studies (130 1949 koruny equal 1955 US $1).

The production series for storage batteries was extrapolated from 1949 to 1955 at an average annual rate of increase of 12 percent and from 1956 to 1963 at 10 percent. The series was moved back from 1949 to 1946 at an average annual rate of decrease of 15 percent, with production in 1938 being estimated to be equal to production in 1947. The production series for primary batteries was extended forward from 1950 to 1955 at an average annual rate of increase of 10 percent and from 1956 to 1963 at 8 percent. The series was extrapolated back from 1949 to 1946 at an average annual rate of decrease of 10 percent, with production in 1938 being estimated to be equal to production in 1947. A 67-percent increase in the output of primary batteries was estimated to have occurred from 1949 to 1950 on the basis of plant expansion in 1949.

The estimates were checked by end-use requirements of automotive storage batteries and radio primary batteries based on CIA estimates 122/ and were found to be of a reasonable magnitude.

5. East Germany.

Estimates of production of batteries in East Germany for 1954 were made on the basis of plant studies. These estimates then were extrapolated to the years from 1949 to 1955 by the index of production of "batteries and elements" (storage and primary batteries) given by the East German government.* 123/ The series was extrapolated forward at an average annual rate of increase of 20 percent, which is slightly less than the average annual rate from 1949 to 1955. The production series for both primary and storage batteries have the same index because only the aggregate index for all batteries is known. The product mix is assumed to be constant over time.

* The production index was computed from the production series given in DME (Deutsche Mark East) by the East German government. The value series could not be used directly, because the value of the currency used is ambiguous. The values appear to be very low in relation to estimated physical production.

From information relating production after World War II to production before World War II and East German production to all German production in the prewar year, 1938, estimates of output were made for 1938 and 1946. 124/ Outputs for the years 1947 and 1948 were estimated by interpolation between 1946 and 1949.

The estimates of output were checked against several estimates of requirements for automotive storage batteries and radio primary batteries 125/ and were found to be of a reasonable order of magnitude.

6. Hungary.

Estimates of production of batteries in Hungary were made from plant studies for 1952, 1955, and 1956. The volume of production in 1935 was established by a quasi-official report made during World War II, 126/ and the relation between the output in 1935 and 1946 was estimated on the basis of plant studies. Thus the average annual rates of growth were determined for the years 1946-56. The production series for storage batteries was extended from 1957 to 1963 at an average annual rate of increase of 30 percent. The series for primary batteries was extended over the same period at a 40 percent average annual rate of increase. It is estimated that there was a reduction in total production of approximately 10 percent in 1957 compared with 1956 because of the Hungarian rebellion.

The production series was checked by estimates of end-use requirements 127/ and was found to be of a reasonable order of magnitude.

7. Poland.

Production of storage batteries in Poland was given in physical quantities for the years 1938, 1947-49, 1953, 1954, 1955, and the first half of 1956. 128/ Plant studies were employed to determine the product mix in order to value the physical production series. Estimates for the years between those given were interpolated. The estimate for the year 1946 was extrapolated from 1947 on the basis of the annual rate of increase from 1947 to 1948. Extension of the series from 1956 to 1963 was accomplished by extrapolation, using the average annual rate of increase from 1950 to 1955 -- 20.6 percent.

Plant studies established the estimate for production of primary batteries in 1956 and the product mix used throughout the series. Estimates for the years 1946, 1949, and 1955 were based on information which expressed total battery production as a percentage of the electrotechnical industry of Poland 129/; the production of primary batteries was based on the difference between total production and production of storage batteries in the given years. Estimates for years between the given years were made by interpolation. Production of primary batteries in 1938 was given. 130/ For the years from 1956 to 1963 the estimates of production of primary batteries were made by extrapolation at an average annual rate of increase of 19.5 percent, the rate which prevailed from 1950 to 1955.

8. Rumania.*

The production series for storage batteries is based entirely on the study of the Accumulatorul Storage Battery Plant, which is the sole producer of storage batteries in Rumania. Production for the years 1938, 1949, 1950, 1951, 1952, and 1954 was estimated from the plant study, and the years between were estimated by interpolation. The series was extended to 1963 at an average annual rate of increase of 20 percent.

Similarly, the production series for primary batteries is based entirely on the study of the Electro Banat Plant, which is the sole producer of primary batteries in Rumania. Production in 1938, 1951, and 1956 was estimated from the plant study, and the years between were estimated by interpolation. The series was extended to 1963 at an average annual rate of increase of 25 percent.

The production series for both primary and storage batteries were checked by estimates of end-use requirements 131/ and found to be of a reasonable order of magnitude.

II. Trade.

Because an estimate of trade in absolute figures was found to be infeasible, an analysis was made of trade patterns and practices. This analysis relies heavily on press statements and State Department despatches, together with a lesser contribution from CIA reports.

III. Inputs.

Tables 13 and 14** show the material inputs of representative categories of the battery industry in the US and the prices of the final products in 1955. Inputs for the representative categories were based on typical requirements for materials in the US. Although a precise representation of inputs and price is difficult to obtain with so few categories, it is believed that the estimates of production suffer

---

* For documentation for the plant study, see Appendix B.
** Tables 13 and 14 follow on pp. 67 and 68, respectively.

Table 13

Estimated Volume and Value of Inputs of Selected Materials for Production
of Storage Batteries a/
with Prices of Final Products in the US

Type of Battery	Material Inputs (Kilograms per Metric Ton of Final Product)								Factory Price, Free on Board (1955 US $ per Metric Ton)
	Antimonial Lead	Nickel	Cadmium	Iron	Steel Container	Nonmetallic Battery Case	Separators and Sealing Compound	Electrolyte	
Starting, lighting, and ignition									
Aircraft	485					164	140	211	732
Automobile, truck, tractor, and bus	450					175	150	225	500
Motorcycle	450					175	150	225	667
Tank	485					164	140	211	524
Motive power									
Industrial truck and locomotive propulsion	500					159	136	205	660
Submarine propulsion	623					120	103	154	1,220
Torpedo propulsion	623					120	103	154	2,200
Stationary	462					171	147	220	450
Railroad diesel starting	500					159	136	205	827
Railroad car air conditioning and lighting	500					159	136	205	1,074
Alkaline storage batteries									
Nickel-cadmium, all types		177	59		288		288	188	3,890
Nickel-iron, all types		186		62	286		286	180	1,500

a. All storage batteries are of the lead-acid type unless otherwise indicated.

Table 14

Estimated Volume and Value of Inputs of Selected Materials for Production of Primary Batteries with Prices of Final Products in the US

	Material Inputs (Kilograms per Metric Ton of Final Product)						
Type of Battery	Carbon	Manganese Dioxide	Zinc	Paper	Sealing Compound	Electrolyte	Factory Price, Free on Board (1955 US $ per Metric Ton)
Flashlight	91	278	233	9	167	222	800
Radio	80	252	272	100	109	187	1,200
Other a/	91	278	233	9	167	222	520

a. Inputs are for general-purpose dry cells.

little error from this source compared with the errors inherent in the sources used as basic data.

Inputs of materials vary with the products selected and combined to represent a category. The error which may be introduced by the selection of particular products also is believed to be minor in comparison with the errors inherent in the basic data. All inputs of materials could not be included, because of the vast variety of materials used in the industry, and therefore only the most critical and indicative inputs have been included.

Estimates of physical quantities were converted to quantities of major inputs by the factors shown in Tables 13 and 14.* This conversion may be made for the estimates of production for any year, but only material inputs for the year 1956 were computed for this report.

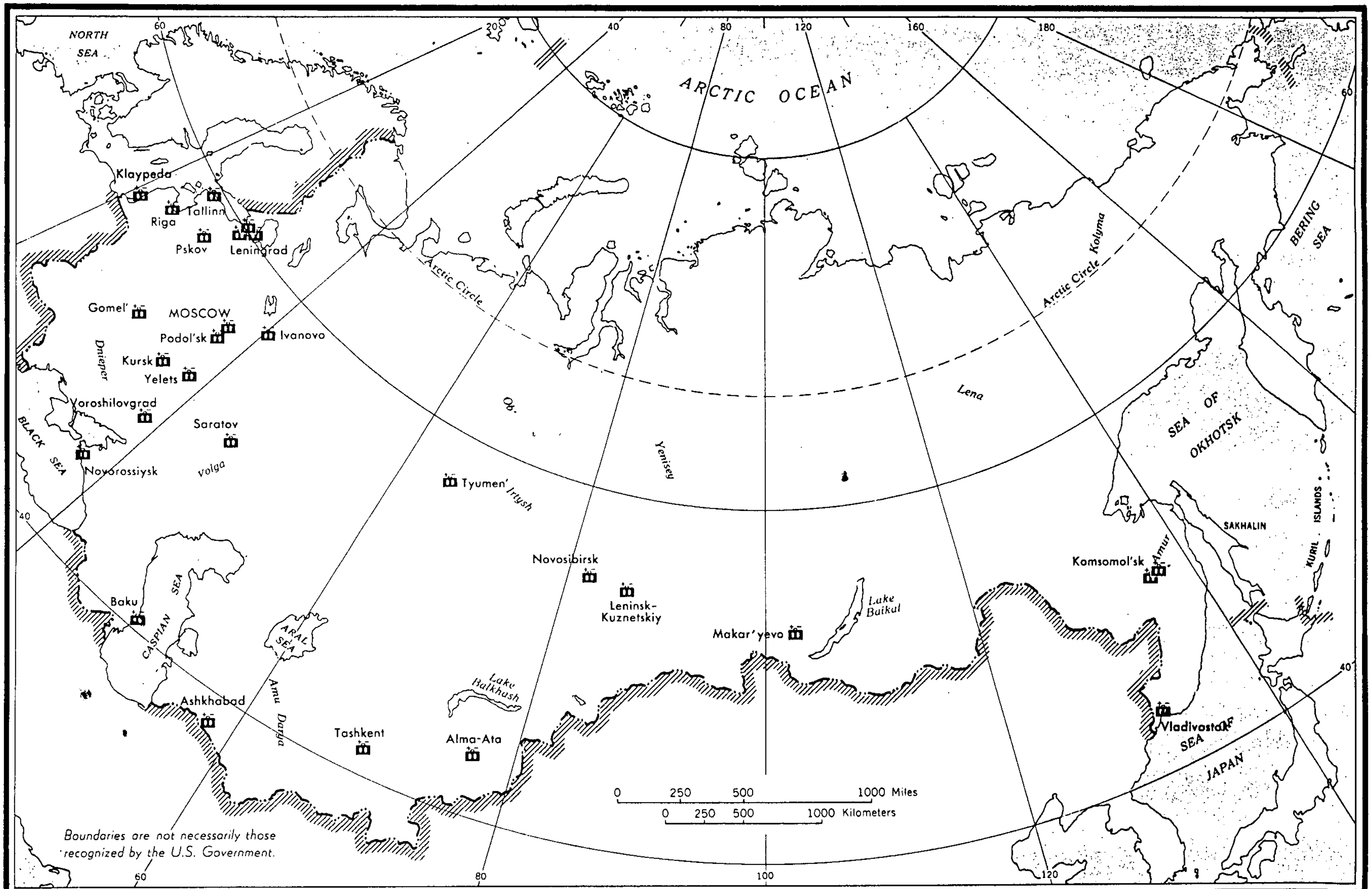
Estimates of the labor force were not computed by analogy to production in the US but are the totals of estimates for individual plants.

* Pp. 67 and 68, above.

~~SECRET~~

Figure 1

USSR: LOCATIONS OF PLANTS OF THE ELECTRIC BATTERY INDUSTRY, 1957



26381 2-58

~~SECRET~~